Perspective

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Analysis and Biomedical Applications of Microfluidics in the Field of TCM

Angela Luyet*

Department of Biomedical Engineering, University of Michigan, Michigan, USA

Corresponding author: Angela Luyet, Department of Biomedical Engineering, University of Michigan, Michigan, USA, Email: angelaluis23@yahoo.com

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Introduction

Traditional Chinese medicine (TCM), which is rich in cultural heritage and has characteristics of advocating and conforming to nature, has demonstrated its significant value to life and health. It is characterized by a singular theoretical system and research methods. For instance, TCM treatments have made incremental progress in the fight against the 2019 Corona Virus Disease (COVID-19). According to clinical observations and evidence, more than 90% of the confirmed cases in China have benefited from six TCM recipes that have been shown to be remarkably effective for treating COVID-19 patients. The use of cutting-edge scientific and technological advancements, particularly learning from interdisciplinary concepts like the integration of TCM and Western medicine, has made the modernization of TCM an inevitable trend on the basis of inheriting and developing advantages and characteristics. Pathogenic bacteria pose a serious threat to the safety of CHMs and can result in adverse reactions as well as chronic disease. Time-consuming operation and the absence of multiplex detection continue to be major drawbacks, despite the fact that culture-based methods—the current gold standard—are sufficiently sensitive. Bacteria were specifically labeled by their corresponding mass tags, which could be released and ionized after laser irradiation following aptamer binding, primer amplification, and DNA hybridization. Without microbial mass spectra databases, the analysis of mass tags could specifically detect multiple bacteria simultaneously. This strategy could be used to analyze pathogens in CHMs and has been used to successfully detect practical milk samples.

Screening and Pharmacological Activity Evaluation of CHMs

In the development of anti-tumor therapy, dynamic and high-throughput drug screening in large-scale cell spheroid arrays has long been anticipated. Liu and co. for high-throughput antitumor screening constructed a microfluidic platform with large multiparallel 3D tumor spheroids. The platform had six groups of pneumatic microstructure arrays, each with four units containing 28 P-Ss. When used in conjunction with the vascular network, the organ microfluidic chip can offer a different method for evaluating CHMs in animal experiments. The blinded screen can test a small library of compounds because each VMO can be addressed independently and has hydrostatic pressure-driven flow. . In order to create artificial structures in which cells and their microenvironment are precisely controlled, organ-on-chips technology uses our understanding of human organs. We developed a summary based on the application of microfluidic chip technology in TCM for the application of microfluidic chip technology in biomedicine and the urgent need for the modernization of TCM. Organoids, on the other hand, develop from self-organizing stem cells and follow intrinsic developmental programs. The quality analysis, delivery, and fabrication of nano CHMs, as well as the screening and pharmacological activity evaluation of CHMs for the prevention and treatment of major diseases, were all examined in depth in this article. With the help of microfluidic chip technology, CHM quality control can avoid variations between batches, monitor pesticide residues, and quickly separate components. Other benefits include low costs, high sensitivity, labor savings, and a small volume. For the study of complicated CHM components, a low-cost, fast, multi-target, microquantification analysis and detection system is in high demand. The study of TCM has increasingly relied on cutting-edge microfluidic technology. A microfluidic chip, also known as a "lab-on-a-chip," is a chip that is several square centimeters in size and incorporates fundamental operating units used in the chemical and biological fields, such as sample preparation, reaction, separation, detection, cell culture, sorting, and lysis. Microfluidics can be widely used in a variety of fields, including disease diagnosis and treatment, drug screening, CHM identification, forensic identification, food hygiene supervision, and environmental testing, thanks to its advantages of high resolution and sensitivity, low cost, short analysis time, and small footprint of analysis equipment. Microfluidics is anticipated to provide a technical support platform for the new design of biological macromolecules and drug development, rapid screening of compounds, and drug development, as well as new avenues for human understanding of the origin, inheritance, development, and evolution of life. Microfluidic chips will become increasingly important in medical research as studies examining the function of individual genes or signaling pathways at the tissue and organ level become essential.

Quantification of Marker Components for Authenticity and Chemical Fingerprinting

Natural plants are the source of CHMs, and the different chemical components of different species of plants tend to affect the quality of CHMs. Therefore, the foundation for their

clinical application is the identification of current CHMs. The description, microscopic observation, and physical and chemical properties, as well as their composition, are the primary focus of CHM identification. These methods of identification frequently necessitate skilled personnel and inefficient equipment. The efficacy of CHMs is greatly impacted by the different plant varieties' tendency to behave differently and to produce toxic substances. Currently, the character, microscopic observation, identification of physical and chemical properties, and composition identification of CHMs are the primary methods for their identification, and related testing is carried out by trained professionals. Additionally, it is more challenging to distinguish between powder and patent medicines. The development of herbal medicine is influenced by a variety of factors, including human factors, biological genetic factors, and environmental conditions, each of which will have its own distinct character. At the same time, discriminators' subjective experiences easily limit character identification, making it impossible to standardize the identification of CHMs with high plasticity, low stability, and repeatability. The growth site and the growth cycle are connected to the type and amount of secondary metabolites. Chemical testing is a common method for the identification and quality control of CHMs and plays an essential role in the quality control of chemical drugs. Quantification of marker components for authenticity and chemical fingerprinting for consistency between batches demonstrate the growing use of analytical techniques like High Performance Liquid Chromatography (HPLC), Gas Chromatography (GC), and Mass Spectrometry (MS) in the pursuit of comprehensive product control.

Perspective

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Contributions of Bioinformatics Tools to the Study of cfDNA

Latifah Awe*

Department of Life Sciences, South Eastern Kenya University, Kenya

Corresponding author: Latifah Awe, Department of Life Sciences, South Eastern Kenya University, Kenya, Email: latifah78@gmail.com

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Introduction

Cell-free DNA (cfDNA) may be useful for early disease diagnosis, prognosis evaluation, and efficacy monitoring as a novel non-invasive marker for molecular detection. Clinical studies on the use of cfDNA detection methods for patients have increased as a result of the constant advancements in molecular biology detection technologies. Numerous positive outcomes have been achieved. Endogenous DNA that has been released into plasma but remains unattached to cells is known as cell-free DNA (cfDNA). Chromosome nuclear DNA enters the bloodstream in the form of cfDNA as DNA fragments and nucleosomes during cell death instead of being encased in a membrane. cfDNA can be found in a variety of body fluids in humans, and its concentration changes in response to things like tissue damage, cancer, and inflammation, for instance. In the field of disease research, liquid biopsies using the cfDNA that circulated in body fluids have emerged as a hot topic.

Fragmentation for Locating Hotspots of cfDNA

Additionally, this group discovered that numerous short fragment sequences were formed in highly accessible chromatin regions in fetal cfDNA. According to Underhill et al., these findings suggested that plasma cfDNA degradation was more closely associated with chromatin accessibility than with cell death or the state of nucleosomes. Determined that melanoma patients had shorter plasma cfDNA fragments and higher plasma cfDNA concentrations than healthy controls. Plasma cfDNA fragments were also found to be small in the group of patients with systemic lupus erythematosus. Numerous studies have demonstrated that while normal nucleosome spacing exists in healthy individuals, morbid states exhibit some abnormalities. The sizes and distributions of plasma cfDNA in various morbid states varied, according to these findings. Rainer and co. studied the relationship between plasma cfDNA and cerebral stroke and discovered a positive correlation between prognosis, mortality, and Rankin scores in patients with cerebral stroke. These results suggested that the plasma concentration of cfDNA could be used to predict stroke mortality. In contrast to healthy controls, researchers at the Johns Hopkins University School of Medicine in Baltimore, Maryland, USA, recently discovered that the lengths of plasma cfDNA fragments in cancer patients varied significantly. With 98% specificity and 73% sensitivity, the researchers were able to predict whether a sample was from a cancer patient or a healthy control by utilizing the variance of the fragment lengths within a genomic interval of 5 Mb. In datasets containing patients with a variety of cancers, they achieved high sensitivity. Zhou and co. developed a method known as Cell Free DNA Fragmentation for locating hotspots of cfDNA fragmentation in plasma cfDNA sequencing data. These models were found to be very useful for predicting the onset and progression of cancer.

Development of Non-Invasive Diagnostic Methods for the Detection of Diseases

Urine cfDNA, in contrast to plasma cfDNA, originates primarily from the reproductive and urinary systems or through filtration in the kidney glomeruli. Urine cfDNA fragments, according to Phoenix Children's Hospital researchers, showed a strong correlation with the expression of genes in related tissues, in contrast to blood (plasma) cfDNA fragments. According to a few studies, this feature of urine cfDNA could be used to monitor patients after kidney transplants, diagnose kidney and bladder cancer, and monitor bacterial infections. As a result, urine cfDNA can be regarded as an excellent diagnostic marker. By extracting cfDNA from plasma or urine samples and carrying out genome sequencing, fragment feature analysis, and genome sequencing, it has the potential to significantly advance its use in the diagnosis of diseases and to generate significant research concepts for the discovery of disease biomarkers. Which primarily include the identification signals of cfDNA tissue sources, methods for identifying cfDNA, and connections between cfDNA and human cancer, end-stage kidney disease, and ischemic stroke? For the purposes of bioinformatics and disease research, the cfDNA that is released into the circulatory system by apoptotic cells in various tissues can offer a wealth of information. Mutation sites, cfDNA fragment pattern patterns, and methylation markers are the primary signals used to identify cfDNA tissue sources. Currently, imaging and cytopathology technologies are used to support the diagnosis of severe diseases, primarily by examining the clinical symptoms of the patient. Most of the time, techniques like computed tomography, ultrasonics, and magnetic resonance imaging are used. However, these methods require a lot of expensive and hard-to-use large equipment. Additionally, patients must be moved multiple times, which severely limits the scope of applications. Different tissues undergo apoptosis to generate

plasma cfDNA. The foundation for the development of non-invasive diagnostic methods for the detection of diseases like cancer has been the study of cfDNA. As a non-invasive early screening tool, plasma methylation biomarkers of various cancers have been investigated, and liquid biopsy has expanded the possibilities for clinical investigations and the early detection of cancers.

Opinion Article

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Personal Perspectives on Future Opportunities and Trends that may bring us Closer to the Promise of Functional ECPs

Steven Abedi*

Department of Medicine, University of Florida, Gainesville, USA

Corresponding author: Steven Abedi, Department of Medicine, University of Florida, Gainesville, USA, E-mail: stevenabedi87@gmail.com

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Description

Over the past few decades, cardiac tissue engineering has advanced; However, the majority of progress in research has been restricted to 3D patches and Engineered Cardiac Tissues (ECTs) with minimal geometrical complexity at the microscale. Despite the fact that their high throughput and standardization make microscale ECTs ideal for drug screening, they have few translational applications in heart repair or the in vitro modeling of cardiac function and diseases. Engineered Cardiac Pusmps (ECPs) with chambered ventricles, for example, that mimic the native heart's geometric complexity, have been the subject of recent research efforts. Their translational applications would be significantly accelerated by switching from microscale ECTs to ECPs at a translatable scale; However, researchers face a number of significant obstacles, including functional maturation, vascularization, and geometrical reconstruction. As a result, the goal of this paper is to go over the most recent developments in bioengineering methods for the production of functionally engineered cardiac pumps. We first audit the bioengineering ways to deal with manufacture ECPs, and afterward underscore the unrivaled capability of 3D bioprinting methods. As researchers have begun to realize the crucial role that the cell density of non-proliferative cardiomyocytes plays in the cell–cell interaction and functional contracting performance, we highlight key advancements in bioprinting strategies with high cell densities. We present a synopsis of the current methods for engineering micro- and meso-scale vasculatures, which are essential for the survival of ECPs and thick cardiac tissues. We grandstand different techniques created to empower the practical development of cardiovascular tissues, impersonating the in vivo climate during heart advancement. By featuring cutting edge research, this survey offers individual points of view on future open doors and patterns that might carry us nearer to the commitment of practical ECPs. The world's leading cause of death is still Cardiovascular Disease (CVD), and the aging of the population in the coming decades will only make it worse. When an artery supplying blood to the heart is blocked, Myocardial Infarction (MI) is associated with ischemic injury, which results in scar tissues with fibrillar collagen and fibroblasts replacing dead cardiomyocytes (CMs) and permanently reduced pumping ability, ultimately leading to heart failure. Heart transplantation continues to be the gold standard for treating late-stage heart failure at this time; be that as it may, constant deficiency of contributor organs and resistant dismissal have forever been incredible difficulties. Hence, there is a convincing requirement for elective methodologies to address the ischemic heart infections.

Engineered Cardiac Tissues Complexity

Stem cell therapies have emerged as a promising strategy for treating heart disease by repairing and regenerating damaged tissue. There are a number of significant obstacles to overcome, including the risk of tumorigenesis, immune rejection of the graft cells, and graft cell death, despite numerous reported clinical practices over the past 15 years. On the other hand, specialists as of late detailed the idea of direct reinventing of scar-tissue following MI into a cardiomyocyte utilizing explicit mixed drink of record factors, which were approved in vitro and in vivo. Nonetheless, in spite of the essential possibility and engaging possibility, it ought to be noticed that such ideas are still in their early stages and specifically, require efficient preclinical approval with respect to somewhere safe and adequacy preceding clinical interpretation.

In contrast, the goal of cardiac tissue engineering is to produce functional in vitro substitutes for cardiac tissue in order to repair or replace damaged myocardium. Engineered cardiac tissues could be used for drug screening and in vitro modeling of cardiac function and disease, in addition to heart repair. For as far back as many years, there have been two particular bearings in the field of cardiovascular tissue designing. The creation of functional Engineered Cardiac Tissues (ECTs) with minimal geometrical complexity at the microscale, such as 3D strips and patches, is one direction. Microscale ECTs are fit for force age and unsurprising reactions to drugs, filling in as promising possibility for drug screening applications. It is well established that the study of drug efficacy, safety, and mechanism of action requires only a small number of cardiac physiological functions. Due to its high throughput and standardization, the geometrical simplification of ECTs is advantageous for drug screening applications.

Applications of ECTs

The development of macroscale Engineered Cardiac Pumps (ECPs), which replicate the geometrical complexity of the native heart and include engineered human ventricles and whole heart models, is the other direction. In order to meet the demand for human grafts, the cardiac patches that have been shown to have limited therapeutic effects in rodent models must currently be scaled up. All the more critically, basically increasing of cardiovascular patches might be lacking to completely reestablish the capability of injury hearts went with worldwide anatomic and physiological changes. For innate heart infections, for example, hypoplastic left heart disorder, a designed ventricle may be a superior transplantation decision. An engineered whole-heart is required to replace the donated heart organ in the future for end-stage heart failure. Contrasted and microscale ECTs, macroscale ECPs might act as a superior model for the investigation of cardiovascular capability and illnesses. For instance, only sarcomere length versus twitch force can be used to evaluate the Frank-Starling relationship, which depicts the physiological relationship between stroke volume and end-diastolic volume in microscale ECTs. Be that as it may, ECPs empower the assessment of tension volume measurements and their immediate examination with human heart execution, consequently can possibly at last supplant the creature models.

Numerous research groups have attempted to fabricate ECPs in various ways over the past few years. By seeding cells on the ellipsoidal electrospun scaffolds, Parker's team created a chamber that resembled a ventricle in 2018. However, the engineered ventricles' wall thickness was limited to around 100 m due to their inherent low cell seeding efficiency, resulting in a contractile strength that was only about 2% of their native counterpart. Embedded extrusion bioprinting, a novel 3D bioprinting technique, has emerged as the most effective method for engineering cardiac pumps. Nonetheless, these heart-like models neglected to accomplish the macroscale contractile capability because of the absence of reached out in vitro culture. Functional development of these macroscale ECPs is still in its infancy, and individual CM maturation within ECPs has not yet occurred.

Commentary

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Computational Intelligence and Machine Learning in Bioinformatics and Computational Biology

Sadanand Samadi*

Department of Medicine, National University of Singapore, Singapore

Corresponding author: Sadanand Samadi, Department of Medicine, National University of Singapore, Singapore, E-mail: sadanandsamadhi34@yahoo.com

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Description

The current advancements in artificial intelligence and machine learning have a significant impact on fields like computational biology and bioinformatics. While Bioinformatics applies standards of software engineering and method to help comprehend the huge, different, and complex life sciences information and consequently make it more valuable, conversely, the Computational Science applies computational ways to deal with address hypothetical and trial inquiries in science. This Exceptional Issue on Computational Knowledge and AI in Bioinformatics and Computational Science contains expanded variants of the vital papers from the eighteenth IEEE Meeting on Computational Knowledge in Bioinformatics and Computational Science which is a significant occasion in the field of computational insight and its applications to issues in bioinformatics, computational science, and biomedical designing. Academic and industrial scientists from computer science, biology, chemistry, medicine, mathematics, statistics, and engineering use the annual conference as a global platform to discuss and present their most recent research findings, from theory to applications.

Pandemics involving a variety of species have been caused by influenza A viruses throughout history. It is vital to recognize the beginning of an infection to forestall the spread of a flare-up. Utilizing machine learning algorithms to make quick and accurate predictions for viral sequences has recently attracted more and more attention. In this review, genuine testing informational indexes and an assortment of assessment measurements were utilized to assess AI calculations at various ordered levels. Because hemagglutinin is the most important protein in the immune response, only hemagglutinin sequences were used, and they were represented by a word embedding and a position-specific scoring matrix. The 5-g-transformer neural network appears to be the best method for predicting where viral sequence origins come from, according to the findings.

AI in Bioinformatics a nd Computational Science

The reconstruction of Gene Regulatory Networks (GRNs) for the purpose of identifying the underlying complex biological interactions is the topic of this paper. For fast and accurate GRN inference, the authors have developed a novel combined filter feature selection method. Utilizing discretized microarray articulation information, the qualities which are generally pertinent to each target quality are first separated utilizing an example based include positioning technique and further quality determination from the sifted quality rundown utilizing a shared data based min-overt repetitiveness max-significance measure. To select the best set of regulatory genes, this combined approach is applied to datasets that have been resampled. Expanding upon the creators' past exploration, a Pearson connection coefficient-based Boolean demonstrating approach is used for the productive ID of the ideal administrative principles related with chosen administrative qualities.

In the third paper named "Genome-scale expectation of bacterial advertisers" of this exceptional issue, two specialists Bernardino and Beiko present examinations in the record of RNA - the limiting of the RNA polymerase protein complex to a short advertiser succession that is regularly upstream of the quality to be communicated. When it comes to figuring out which genes are most likely to be expressed and when, the proposed automated identification of promoters is a useful addition to experimental validation. However, the short and highly variable nature of promoter sequences makes it extremely challenging to accurately classify them. In this paper, the creators present Teacher, a brain network-based strategy that utilizes various kinds of DNA encodings and tunable responsiveness and particularity boundaries. Commentator forecasts were additional reliable in the homologous subset of grouping from a kind of Salmonella than they were with one more type of E. coli. The study looked at Expositor's ability to tell between different classes of promoters. It found that misclassification between classes was consistent with promoters' biological similarity.

The recently proposed dimensionality reduction technique known as SONG is the subject of this study, which aims to determine how biological data can be used to capture both discrete and continuous structures. Utilizing mimicked and genuine world datasets, they see that Melody produces astute representations by saving different examples, including discrete bunches, continuums, and spreading structures in completely considered datasets. Additionally, the comparable quality of the SONG's low-dimensional embeddings is confirmed by quantitative evaluation of the methods using downstream analysis.

High-Quality Molecular Structures

The use of microorganisms to make compounds and enzymes that are important to industry is the focus of the paper. Due to the complexity of their biology and genomic structure, eukaryotes have been used in biotechnology less frequently than prokaryotes. The international Yeast2.0 project uses a system called SCRaMbLE to engineer the yeast Saccharomyces cerevisiae to be easy to manipulate and to generate random variants. Using an evolutionary computing method, the authors create a system simulator in silico. They applied the framework to the examination of the wellness scene of one of the S. saccharomyces chromosomes and found that the outcomes fitted well with those recently distributed. They then simulated directed evolution with or without SCRaMbLE manipulation, demonstrating that SCRaMbLE process control can have a significant impact on directed evolution.

The requirement for learning an enormous number of S-framework model boundaries for demonstrating hereditary organization brings about expanded computational weight. The direction, nature, and intensity of the genetic interactions are represented by the paper's two kinetic parameters, gij and hij, which are effectively learned. Because they are independent, these two parameters may converge to values that may suggest opposing gene interactions. In this study, the authors have created a novel approach with two characteristics: a penalty term that penalizes networks with incorrect kinetic orders and a parameter called wij that is created by combining the gij and hij kinetic parameters. During the process of optimizing the DRNI Dynamically Regulated Network Initialization algorithm, the novel penalty term was utilized for candidate selection. The systematic elimination of invalid networks and the creation of valid candidate solutions are both facilitated by this strategy. On a variety of gene expression datasets, the method was able to produce improved network accuracies and reduce the number of iterations.

Adversarial Deep Evolutionary Learning (ADEL) is the new method that the authors suggest for searching for novel molecules in the latent space of an adversarial generative model and continuously improving the latent representation space. In ADEL, a uniquely crafted ill-disposed autoencoder (AAE) model is created and prepared under a profound developmental learning (DEL) process. When the AAE is used for training, any distribution can be used, and the latent representation space is set to that distribution. This takes into consideration a beginning inert space from which new examples are created. After each iteration of training, new high-quality samples are produced throughout the learning process. The generative model and the data can both be improved through this combination of evolving data and continuous learning. In addition to virtual and experimental screenings, ADEL is able to design high-quality molecular structures.

Commentary

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Review of *In Vitro* and *In Vivo* Degradation of Magnesium Alloys in Terms of Degradation Mechanism, Influencing Factors, and Corrosion Products

Shraddha Gupta*

Department of Biotechnology, Delhi Technological University, Delhi, India

Corresponding author: Shraddha Gupta, Department of Biotechnology, Delhi Technological University, Delhi, India, E-mail: shraddhagupta34@gmail.com

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Description

Magnesium amalgams have become promising biomedical metal materials on account of their biocompatibility, degradability, and great mechanical properties. Be that as it may, the quick debasement of magnesium combinations and its related impacts have restricted the uses of magnesium composites. Alloying and planning cycles can diminish the corruption rate by changing the microstructure of magnesium combinations, for example, grain size, porosity, development of intermetallic builds/second stages, and so on. In this paper, the *in vitro* and *in vivo* debasement of magnesium composites were audited with regards to corruption component, impacting variables, and consumption items. Control methods for degradation included surface treatment and structural design, while composition design and the manufacturing process were the primary topics of discussion. This assists in achieving the objective of controlling and predicting the rate of degradation of magnesium alloys.

Metal, ceramic, polymer, and composite biomaterials are examples of existing biomaterials, as are biomaterials that are degradable and those that are not. Due to their excellent mechanical properties and good biocompatibility, metal biomaterials are frequently utilized in clinical treatment to repair or replace damaged tissues and organs to restore their functions. In recent years, in contrast to more conventional biologically inert metals (such as stainless steel, titanium alloy, cobalt-based alloy, and so on), Biodegradable metals are receiving a lot of attention. There are three main categories of biodegradable metal materials: magnesium combination, ferroalloy, and zinc composite. The creation of magnesium alloy for the treatment of cardiovascular disease and orthopedic repair has received a growing amount of attention. This worry comes from magnesium's astounding biocompatibility and mechanical properties, clear bone conductivity, and degradability. However, the magnesium's rapid degradation rate remains a significant obstacle to its widespread use. As a result, biodegradable magnesium alloys with controllable degradation rates must be developed immediately.

In the flow research, the techniques to further develop the corruption issue of magnesium composites mostly incorporate microalloying, heat treatment, surface covering, and underlying model. The magnesium substrate's inner layer is protected from bodily fluids by the surface coating.

Clinical Treatment to Repair Damaged Tissues

Assuming the covering is broken, the magnesium substrate will in any case be seriously eroded. As a result, the magnesium alloy's microstructure is designed to improve its resistance to corrosion. In such manner, some examination results have slowly arisen. Jin and co. compared the microstructure and corrosion properties of magnesium alloys with (0.2 wt percent) Ca, Sr, Ag, In, and Cu elements added to Mg-0.5Zn alloy, with Mg-Zn-Ca exhibiting the highest corrosion resistance of the five alloys. The properties of the second phase particles, rather than the grain size, are largely responsible for the degradation rate of the Mg-Zn series with Ce and Ca elements. Moreover, the expansion of uncommon earth components like Y, Gd, and Sc to magnesium composites is likewise a focal point of ebb and flow research. Corrosion can be lessen by using rare earth elements. Calderon arranged eutectic layers (α-Mg and β-Mg17Al12) on the magnesium network to shield it from consumption. Likewise, new Mg-Zn composites have been created in late examinations. Torabi suggested that Mg-5HA was resistant to corrosion well. Bakhsheshi-Ra and others Graphene nano-platelets were used to reinforce magnesium-based composites. Nie and others made ultrafine-grained magnesium alloys by adding TiC nanoparticles to the Mg-1.12Ca-0.84Zn-0.23Mn (at percent) alloy. It is not difficult to comprehend that the alloy's precipitated phase and matrix phase may undergo distinct degradation rates depending on the selection of alloying elements and element content.

The fundamental principles of degradation mechanism, influencing factors, corrosion products, corrosion types, and degradation differences *in vivo* and in vitro have been widely accepted throughout the many years of research on magnesium alloys. Magnesium alloys' primary research areas are still the control of degradation rate and ion release behavior. This paper provides ideas for the creation of biological magnesium alloys with controlled, uniform, and predictable degradation rates by summarizing the research on the change in degradation rate of

biological magnesium alloys, highlighting the issues magnesium alloys currently face, and offering solutions.

Cardiovascular Stents

In 1878, magnesium alloys were used for the first time to ligate arteries, demonstrating the benefits of biodegradable materials for humans. Bio-magnesium alloys have since been studied for bone injuries, dental issues, severe trauma, and coronary artery disease treatment. Cardiovascular stents are currently the subject of numerous clinical trials. Within six to twelve months, coronary stents complete the arterial remodeling process and degrade with optimal mechanical integrity. The corrosion mechanism of magnesium alloys is also complex because the service environment of biomedical pure magnesium or magnesium alloys is in a body fluid that is extremely complex and corrosive. The public has generally accepted the current research's findings that the corrosion products of the electrochemical reaction between magnesium and water are hydroxide and hydrogen. When magnesium alloys are inserted into an organism, they may come into contact with muscle, bone, and bone marrow. Since SBF lacks proteins and other organic components *in vivo*, there are some distinctions between *in vivo* degradation and *in vitro* degradation in simulated body fluids. *In vivo* degradation has a significantly different pH value than in vitro degradation. Due to their excellent biocompatibility, biodegradability, and suitable mechanical properties, biomedical magnesium and its alloys have received a lot of attention. Nonetheless, the greatest restricting element for the clinical utilization of magnesium compounds is as yet the quick debasement rate, bringing about short help time and hydrogen bubbles. A certain degree of protection is provided by the corrosion products produced by the chemical reaction between magnesium and water.

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Development of Antibiotic Resistance Due to the Ribosomal Methylation

Timothy Obisesan*

Department of Microbiology, North-West University, Mafikeng, South Africa

Corresponding author: Timothy Obisesan, Department of Microbiology, North-West University, Mafikeng, South Africa, E-mail: timothyobisesan54@hotmail.com

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Description

Antibiotics are generally regarded as the cure for infections. Over the course of several decades, these antibiotics have been utilized extensively worldwide. Antibiotics saved the lives of several million people worldwide. Sadly, the bacteria are known to spread worldwide and have developed multiple drug resistance mechanisms. A few bacterial disengages including gram positive microscopic organisms, for example, Methicillin Safe Staphylococcus Aureus (MRSA), Vancomycin Safe Enterococci (VRE) and carbapenem drug safe gram negative microorganisms including Enterobacteriaceae, Pseudomonas aeruginosa and Acinetobacter Sp are known to cause contaminations prompting high horribleness and mortality.

The bacteria have come up with a number of ways to avoid the action of antibiotics. Some of these ways are to inactivate or change the antibiotics, change the target site so that the antibiotics don't stick as well, change the metabolic pathways, and lessen the amount of antibiotics that accumulate inside the cell because more antibiotics are flowing through it through afflux pumps. It has long been known that the ribosomal region, which includes the decoding center of the 30S subunit, the peptidyltransferase center, the GTPase center, and the 50S subunit, is the primary target site for antibiotic actions.

MRSA Resistance Mechanisms

Microorganisms developed an exquisite approach to forestalling of the limiting of the anti-toxins to the ribosomal district by the expansion of the methyl gathering to rRNA leaned toward by methyltransferase chemicals, this methylation forestalls the limiting of various classes of medications prompting the improvement of the medication obstruction. S-adenosyl-L-methionine is used as a cofactor by a number of methyltransferase enzymes to encourage the methyl group to bind to 23S rRNA. Due to the expression of the EmrC RNA methyltransferase, which causes N-6 dimethylation of adenine at position 2058 in 23S rRNA, the erythromycin resistant gram positive bacteria were resistant to unrelated classes of antibiotics such as lincosamide and stretogramin B. These antibiotics were not related to erythromycin. The methylation of 23S rRNA by a number of erm methyltransferases has been found to confer drug resistance.

The aviRa gene, which methylates the V domain of the 23S rRNA and confers resistance to avilamycin, is a rRNA methyltransferase gene. Drug resistance to five distinct classes of antibiotics, including phenicol, lincosamide, oxazolidinone, pleuromutilin, and streptogramin, as well as to macrolides, is conferred by the cfr (chloromphenicol/florfenicol) gene, which promotes methylation in the A2503 region of the 23S rRNA. Studies have shown the presence of cfr and improvement of multidrug obstruction and were disengaged from bacterial disconnects got from the nosocomial diseases making them a strong hotspot for the spread of multidrug opposition. Comparably a few different qualities encoding the methyltransferase catalysts were found which present the medication opposition through the methylation of 23SrRNA. The emtA a rRNA methyltransferase presents methylation at the buildup of the G2470 prompting the improvement of high medication protection from the evernimicin.

Spread of Multidrug

The rlmA encodes methyation at G748 area presenting drug protection from the tylosin and tsr quality prompts the advancement of medication protection from the thiostrepton because of methylation at A1067 locale at the place of 2'- O-ribose of 23S rRNA. The medication obstruction because of 23S rRNA has been accounted for around the world. Methylation of 16S rRNA, in addition to 23S rRNA, has been shown to promote drug resistance. Against aminoglycosides, methylation of the 16S rRNA has emerged as a drug-resistant mechanism, particularly in gram-negative bacteria. Several methyltransfrases that are encoded by a number of genes, including armA, rmtA, rmtB, rmtC, rmtB, rmtE, and npmA, have been found to add a methyl group to 16S rRNA. High levels of resistance to gentamicin, tobramycin, amikacin, and plazomicin are caused by the majority of these methyltransferases' posttranscriptional methylation of 16S rRNA residue G1405. The medication obstruction due to16S rRNA has been accounted for overall with next to no territorial conveyance. To determine the options for treatment, it is necessary to ascertain the direct clinical impact resulting from the presence of these methyltransferase enzymes that cause aminoglycoside drug resistance. Due to methylation in the ribosomal region, drug resistance to several antibiotic classes has developed, which is concerning for the treatment.

The isolation of Staphylococcus aureus, which is resistant to linezolid and possesses the cfr gene, which confers drug resistance to various classes of antibiotics, is one example of the outbreak of multi-drug-resistant organisms, as demonstrated by several studies. The potential spread of these genes among clinical isolates may result in a rapid and simultaneous rise in antibacterial class resistance. Advancement of anti-infection obstruction due to the ribosomal methylation raise worries about the future clinical viability of a few antimicrobial classes.

Research work is proceeding to avoid the methylation method of medication opposition including planning new anti-infection agents which are not impacted by methylation, or inactivation of methyltransferase proteins through clever peptides. In conclusion, a better understanding of these methyltransferases' mode of action and increased research efforts to develop drugs that can overcome drug resistance based on ribosomal methylation pave the way for improved treatment outcomes.

Perspective

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Recent Achievements of Discrete Polymers in Optical Imaging, Magnetic Resonance (MR) Imaging, and Therapeutic Applications

Maryam Madani*

Depatment of Cyber Science and Technology, Beihang University, Beijing, China

***Corresponding author:** Maryam Madani , Depatment of Cyber Science and Technology, Beihang University, Beijing, China, E-mail: maryammadani67@yahoo.com

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Description

The rapid expansion of digital channels that make it easier to buy and sell goods and products has contributed to the worldwide increase in counterfeit product sales. These channels thrive on the idea of connecting consumers directly with manufacturers to save money, but they don't show much about where products come from. Clearly, forgers profit by the pervasiveness and secrecy of online channels to acquire simple admittance to shoppers.

According to Grossman and Shapiro, counterfeit goods can be broken down into two categories: both non-deceptive and deceptive. For products that are not deceptive, the consumer is aware of the illegitimate nature of the product, is able to easily distinguish the counterfeit product, and willfully purchases the counterfeit product at a price that is significantly lower than that of the genuine product. This work focuses on deceptive products, which are the other category. The most widely recognized model and the fundamental inspiration for the displaying system that we propose is fake prescriptions, where the buyer can't recognize a fake and a veritable item and hence unwittingly buys the fake item at a market value that is typically close or equivalent to assuming the item is certified.

Drug forging is an extravagant industry that is compromising the prosperity of society and the financial soundness of the drug business. The World Wellbeing Association characterizes a fake medication as "one which is intentionally and falsely mislabelled concerning personality or potentially source". These counterfeit drugs are sold with the intention of deceiving consumers and may contain the correct or incorrect ingredients or the wrong quantities of the correct ingredients. According to Cockburn, Newton, Agyarko, Akunyili, & White, consumers are then offered counterfeit goods at prices comparable to those of genuine goods. Legislation is constantly being enacted and the most recent technology is being utilized by both public and private sectors to assist in resolving this issue. For instance, the Obama administration enacted a law to protect drug distribution networks that mandated that drug packages include unique serial numbers for tracking purposes by 2017.

Application of Blockchain

Although blockchain technology holds the greatest promise for combating drug counterfeiting, the issue is far more complicated than the application of blockchain, RFID, or serial numbers alone. First and foremost, consumers should be able to easily access the verification via text messaging or a website. Second, all substances in the production network ought to participate to stay up with the latest. Thirdly, all stakeholders in the supply chain should have access to secure technology, like blockchain. However, a significant issue arises for the pharmaceutical supply as a result of this ease of access. Counterfeiters, just like consumers, have access to these databases and could alter the process by which records are verified.The pharmaceutical industry's high hopes for blockchain technology's tracking and authentication verification capabilities are the impetus for this work. However, all parts of the supply chain need to work together in a dedicated and coordinated manner for this to work as expected. The awareness that counterfeiters are constantly improving their strategies to combat such endeavors is also crucial. Blockchain only authenticates the record, not the product, due to its security and fortification. If they are leaked, records could very well validate a fake product at the expense of a genuine one. Despite the fact that the pharmaceutical industry serves as a driving force behind the current work, it can also be applied to other products. As such the article will be kept general, yet the rousing model is chiefly fake medications. This influences a portion of the suppositions embraced, which we will allude to later. We know that both, tricky and non-misleading fakes, lead to huge social and monetary misfortune with extreme results to purchasers as well as brand proprietors. Clearly, recognizing tricky fakes is altogether harder because of the misleading idea of the items as well as their normal penetration into the proper appropriation channels of veritable items. As a result, each product can be tracked individually from production to delivery, increasing transparency in the supply chain and the ability to distinguish genuine products from counterfeits. one of a growing number of businesses that provide solutions for tracing products from the manufacturer to the end user, maintaining a safe record of the product's origin, characteristics, and ownership.

Implications of Using Blockchain

Blockchain provides a tracking technology for tracing the origin of goods throughout the supply chain, thereby combating counterfeiting. The store network substances can then do quality confirmation at various levels of the inventory network by assessing the record for every item and adding data that can be utilized downstream in the store network as the item goes to retail and in the end to purchasers. Before selling the product to the customer, the retailer can then examine the recorded transactions and determine the product's authenticity. The added benefit of blockchain is that it provides an immutable, decentralized record tracing layer that is visible to all entities in the supply chain as well as consumers. This is despite the fact that these smart tags are already widespread tools that are utilized as counterfeiting technologies. Because more information is now available for all entities as well as consumers to verify the records rather than having partial information siloed and entities that can only verify local information, this layer of visibility constitutes a very important aspect in the prevention of counterfeiting. In addition, the immutability of the data stored on the blockchain is a crucial security feature that ensures that the digital record cannot be altered. Even though the virtual record cannot be changed, the physical product is still susceptible to counterfeiting, which can be done by either cloning the smart tag and making multiple products with the same smart tag that links to the real record or by replacing the original product in the packaging. Accordingly it depends on the store network substances to settle fair and square of straightforwardness in the production network. The technology required to read the smart tag and push the information to the blockchain as well as the cost of the blockchain itself make it expensive to store data on the blockchain. Then again, extra data and continuous record refreshes give more abilities to distinguish irregularities and improve the probability of recognizing unlawful items. The strategic implications of using blockchain to prevent the sale of counterfeit goods are examined in this paper. Especially, this paper researches the utilization of blockchain to kill the huge monetary benefit from the deals of misleading fakes. By to some degree keeping fake items from arriving at clients, the provider of misleading items acknowledges less benefits in the end arriving at a level where it is at this point not monetarily appealing to endeavor to sell fakes. Naturally, adopting blockchain technology for the purpose of detecting counterfeits is expensive for brand owners. As a result, the purpose of this paper is to investigate the critical tradeoff between the expense incurred by suppliers and manufacturers of genuine products as a result of increasing adoption of blockchain technology and the potential benefit of making it less appealing to counterfeiters.

Opinion

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Evaluation of the Quantities of Medical Waste Generated and the Factors Associated with the Generation at Medical Institutions in Taiwan

Chao Chung Liao*

Department of Biological Sciences, National Taiwan University of Science and Technology, Taiwan

Corresponding author: Chao Chung Liao, Department of Biological Sciences, National Taiwan University of Science and Technology, Taiwan Email: chaochung45@gmail.com

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Introduction

After the implementation of the National Health Insurance (NHI) system, hospitals have continually been improving the quality of medical treatment, and accepting more patients than before, thus resulting in an increased amount of workable hospital waste. Ho (2011) found that the amount of medical waste from disposable medical products has increased since the implementation of the NHI system. Among the hazardous waste types, the amount of infectious medical waste has increased at the fastest rate. In order for hospitals to handle such large amounts of medical wastes, they outsource registered waste treatment companies for transportation and disposal of wastes, which leads to a higher waste management cost for hospitals. According to medical statistics from the Ministry of Health and Welfare of Taiwan, the total wastes from regional hospitals reached 97,698 metric tons in 2011. A study was conducted to evaluate the quantities of medical waste generated and the factors associated with the generation rate at medical institutions in Taiwan. The total average quantity of infectious wastes generated was the highest in medical centers, or 3.8 times higher than that in regional hospitals. A Study found that the estimated quantity of medical waste from hospitals is about 22 tons/day and the average generation rate is 0.63 kg/bed/day. Recyclable materials are collected separately at a rate of 83%.

Sustainable Waste Management Model

Currently, waste management in hospitals is based on the waste disposal act. Although the management of biomedical waste disposal companies is effective, according to regulations, institutions that produce waste must be responsible for safe and proper waste disposal. Hence, when waste disposal management relies on outsourced companies and the waste is problematic, hospitals are still held responsible. Given this, hospitals should be extremely careful about the outsourcing risk of biomedical waste. Morrisey and Browne suggested that most of the municipal waste models identified in the literature are decision support models, which, for the purposes of this research, are divided into three categories those based on cost benefit analysis, those based on life cycle assessment and those based on multi-criteria decision making. Moreover, Morrisey and Browne suggest that even though a sustainable waste management model must consider environmental, economic and social aspects, no model so far has considered all three aspects in application. Most hospitals are concerned about economic factors, and biomedical waste disposal is based on market prices. Mere focus on price competition leads to the detriment of the social and environmental welfare. Therefore, hospitals must carefully evaluate risk-price tradeoffs in both short and long-run scenarios.

Factors Regarding Outsourced Biomedical Waste

Taiwan has imposed a very strict set of laws and regulations concerning the production, disposal and processing of medical wastes. However, medical institutions may violate these laws unknowingly. The penalties for violation are insignificant, but the violation may damage the medical institutions' reputation. This study proposes suggestions to the hospital administrators regarding the selection of outsourced biomedical waste disposal company, in order to guarantee proper disposal and quality of medical service. As the hospitals are the producers of wastes, they also need to strengthen the management and examination of wastes, in order to lower the risks after outsourcing. Medical wastes generally include controlled medical waste, bio-hazardous waste, isolation waste, biomedical waste, and potentially infectious waste. FMEA focuses on workflow processes and systems factor analysis, and investigate and illustrate a medical institution's risks related to biomedical waste outsourcing. These factors reflect the dangerous handling factors regarding outsourced biomedical waste, which should be concerned by hospitals when assessing and selecting the biomedical waste management company to effectively reduce their risks. Biomedical waste outsourcing and handling are one of the administrative tasks of hospitals.

Commentary

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Quantitative Approach for Assessing Hazards and Hazardous Waste Management Practices

Ka Yu Wong*

Department of Biomedical Sciences, Murdoch University, Australia

Corresponding author: Ka Yu Wong, Department of Biomedical Sciences, Murdoch University, Australia, Email: kayuwong67@yahoo.com

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Introduction

Making decisions about how to manage hazardous waste is made easier when hazards are assessed quantitatively. The physical, human health, environmental, and amenity hazard aspects and risks (in the event of exposure) of waste streams were evaluated using a scoring method in this study. The 15 Hazard Properties (HPs) outlined in the Waste Framework Directive 2008/98/EC of the European Commission and their associated Globally Harmonized System of Classification and Labeling of Chemicals (GHS) hazard statement codes (H-codes) served as the foundation for the strategy. Amenities and other risks, such as the need for space, odor, dust, vermin, visual impact, radioactivity, and physical harm, were also taken into account. Each of the H-codes—amenity and other hazards—received a score between 0 and 3. The scoring strategy included: 1) determining the composition of the waste; 2) utilizing waste composition as a basis for searching H-codes and assigning H-codes to the associated HPs; 3) determining the risk score for each of the four risk factors; determining the total score for each waste, and 4) For 29 hazardous wastes, the total hazard score was determined using two approaches.

Variety of Hazard Assessment Techniques and Indices

The wastes were ranked on a hazard scale to show how dangerous they might be. Prioritizing waste management efforts can be accomplished with the help of the new hazard scoring method.In the 21st century, the rapid expansion of industrialization, urbanization, intensive agriculture, and the exploitation of natural resources has resulted in the production of a large quantity of waste that can be considered benign or extremely hazardous. When improperly stored, treated, transported, or disposed of, hazardous wastes may pose risks to human health and the environment. Wastes are categorized as either hazardous or non-hazardous to guarantee safe handling, transportation, reuse, and disposal; Special regulations and precautions apply to hazardous waste. Although the Environmental Protection Agency (EPA) of the United States coined the term "hazardous waste," there is no universally accepted definition, so the definition of waste as hazardous varies from country to country. The majority of countries classify hazardous waste either by listing the types of waste that are deemed hazardous or by identifying the characteristics that make a waste hazardous. In the literature, a variety of hazard assessment techniques and indices have been proposed to help prioritize management efforts and rank hazardous chemicals and wastes. By taking into account the potential threats the wastes pose to human health, the environment, and/or physical safety, these assessment techniques generate hazard scores. The scores from each of the hazard classes are then typically combined to produce a single-value score that is used to represent the wastes' overall hazard ranking.

Hazardous Waste Management Efforts and Practices

Amenity hazards like space, odor, dust, vermin, visual impact, radioactivity, and physical injury are not taken into account in any of these approaches. To rank the relative dangers of wastes, a novel hazard scoring method that takes into account physical safety, human health, the environment, and amenities was developed in this study. The total hazard score for the 29 wastes listed as hazardous in Australia was determined using two approaches. By multiplying the exposure by the total hazard scores, the risks posed by the wastes can be determined. The new scoring method for hazards and risks in the event of exposure aims to help put hazardous waste management efforts and practices first. The National Pollutant Inventory (NPI) and Latimer approaches were used to develop the method for calculating scores for ranking hazard attributes. Each hazard attribute received a score between 0 and 3, just like in the NPI and Latimer approaches. Based on the EU hazard property list, a new scoring approach with two alternative calculation methods was developed for evaluating hazards and risks if exposure occurs of waste streams based on their physical, health, environment, amenity, and other hazards. However, this work used the hazard statement codes (H-codes) from the Globally Harmonized System (GHS) of Classification and Labeling of Chemicals instead of the former European risk phrases. The presence or absence of substances in the 29 hazardous wastes that were evaluated was used to demonstrate the applicability of the two approaches.

Commentary

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Targeted Nanomaterials Including Inorganic Nanomaterials, Organic Materials in Developing Sensors for Shelf Life of Food Products

Zheyan Fang*

Department of Food Engineering and Technology, Tezpur University, Assam, India

Corresponding author: Zheyan Fang, Department of Food Engineering and Technology, Tezpur University, Assam, India, Email: zheyanjosh34@gmail.com

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Introduction

Sensors for food analysis, biodegradable packaging, edible food packaging, intelligent packaging, and active packaging are just a few of the numerous food applications for which nanomaterials are extensively utilized. In addition, the food industry employs nanomaterials as nanoadditives, nanocapsules, gelating agents, nanocarriers, anticaking agents, and other applications. Food safety, preservation, and functionalization are the primary roles that nanotechnology plays in ensuring food security. For the purpose of ensuring the safe delivery of food products to end users, food quality and safety must also be measured. In this setting, spectrometric and chromatographic analytical techniques are frequently utilized to measure the stability of the food components. However, the development of sensors for detecting food components (vitamins), ethylene concentrations, volatile gases, biogenic amines, and toxins is directed by the time-consuming and laborious nature of the aforementioned processes. Because food produces a variety of volatile gases, amines, and other compounds when quality declines, the detection of these components can assess the quality of the food. Several amines, including trimethylamine, ammonia, and dimethylamine, are thought to be indicators of fish freshness in this regard.

Properties of Gold Nanoparticles

Additionally, the measures of food quality (freshness and quality-degrading components) and safety are included in the shelf life analysis of food products, making it extremely important. The presence of any toxic components (patulin and Staphylococcal Enterotoxin B), the presence of undesirable food additives (Sunset yellow and tartrazine, orange II and rhodamine B), and other factors are typically included in the shelf life analysis of food products during storage. The undesirable food quality may develop throughout the entire storage life, beginning with the collection of raw materials, processing effects, storage time, or transportation, or both. Drugs, pesticides, various toxins, undesirable additives (such as colorants), and other external components can also shorten food products' shelf lives or cause issues throughout their entire life cycle. In this context, a variety of sensors are developed to evaluate the safety measures, spoiled food, and food freshness. Pathogens, adulterants, degradation metabolites, toxins, and allergens can all be detected through the use of sensors in the food industry. Direct (freshness, ripeness, microbial, leakage) and indirect (time-temperature indicator, radio frequency identification) freshness sensors can also be found in food. Transducing elements (electrochemical, optical, and mass-based biosensors) and bio recognition elements (antibody, DNA, and enzyme) are also the foundation of biosensors. Titanium dioxide, gold nanoparticles, silver nanoparticles, zinc oxide, quantum dots, and magnetic nanoparticles are some of the inorganic nanomaterials that can be used to create sensors for determining food products' shelf life and quality. Anatase, rutile, and brookite are the three phase structures of titanium oxide, a transition metal oxide. It is a cheap, non-toxic, inert metal that has the potential to fight off a variety of microorganisms. In addition to serving as a biosensor, titanium dioxide is frequently used as a sensor in a number of other applications, such as (i) determining the freshness of pork, (ii) determining the shelf life of mango, eggs, and fish, (iii) determining the presence of histamine in salmon fillet, and (iv) serving as a gas sensor to determine the freshness of fish. Silver nanoparticles are antiviral, antibacterial, anti-inflammatory, anti Shoes, clothing, paints, plastics, appliances, and other items can all benefit from silver nanoparticles' antibacterial properties.

Development of a Sensor for Quality and Safety Detection

The properties of gold nanoparticles include chemically inert, biological compatibility, high stability, high surface area to volume ratio, high dispersity, non-cytotoxicity, plasmonic nanoparticles, strong scattering properties, and high electrical and heat conductivity. The biomedical application of ZnO NPs includes tissue engineering, anticancer, antibacterial, angiogenesis, drug delivery, immune therapy, gene delivery, biosensing, bioimaging, and antidiabetic. Electron transporting artificial nanocrystals are known as quantum dots. After colloidal synthesis, plasma synthesis, viral assembly, and electrochemical assembly, the quantum dots are made. In addition, graphene quantum dots are utilized as multifunctional sensors, an optical

glucose sensor, a photoluminescent pesticide detection sensor, a visual copper ion detection sensor, and for phenols in olive oil detection. Quantum dots, on the other hand, are widely applicable to drug delivery, imaging, and sensor applications. Polymeric nanomaterials, such as dendrimers, hyperbranched polymeric nanoparticles, covalent organic frameworks, molecularly imprinted polymeric nanoparticles, and polymer nanocomposites, are examples of organic nanomaterials. The development of a sensor for quality and safety detection during food product shelf life makes use of titanium dioxide in conjunction with other materials. Nanosensors are a new technology with limited potential for biological systems. It may be challenging to differentiate sensor-induced aberrations from fundamental biological events because of the potential for some nanosensors to disrupt cell metabolism and homeostasis, altering cellular and molecular profiles. Nanosensors require a high degree of accuracy to be manufactured due to their small size and susceptibility to various synthesis procedures, posing additional technological challenges. Nanosensors face difficulties with dispersion, establishing repeatable calibration procedures, and utilizing preconcentration and separation processes. In terms of freshness monitoring, spoilage detection (volatile gas and amines), and safety measures to ensure the safe consumption of food products, the nanotechnology-based sensors are extensively utilized in shelf life analysis. A wide range of properties, including high catalytic activity, chemical property, biological activity, surface chemistry, photocatalytic activity, and others, can be exhibited by nanomaterials, including carbon allotropes, inorganic nanomaterials, and organic nanomaterials. In addition, the utilization of the specified nanomaterials in combination results in enhanced sensitivity for a number of food components, as well as increased selectivity, reproducibility, and sensitivity—all of which are essential characteristics for sensors. As a result, its improved properties, which result from the synergistic effects of combining nanomaterials, make it more appealing for food shelf life detection sensors. In addition, in order to guarantee the safe and healthy delivery of food to end consumers, more intensive research in this field will necessitate the production of these sensors on a large scale in the future.

Opinion Article

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Soft Computing: A Comprehensive Overview and Applications

Mithilesh Amin*

Department of Biomedical Engineering, Lovely Professional University, Phagwara, Punjab, India

Corresponding author: Mithilesh Amin, Department of Biomedical Engineering, Lovely Professional University, Phagwara, Punjab, India, Email: mithileshamin45@gmail.com

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Introduction

Soft computing is a subfield of computer science that encompasses various computational techniques aimed at dealing with imprecision, uncertainty, and partial truth. This research article provides a comprehensive overview of soft computing, including its fundamental concepts, methodologies, and applications. The article emphasizes the three major components of soft computing: fuzzy logic, neural networks, and evolutionary computation. Furthermore, it explores the synergy between these components and their integration into hybrid systems. The article also highlights the wide-ranging applications of soft computing in various domains such as pattern recognition, optimization, control systems, and decision-making. Overall, this research article aims to present a comprehensive understanding of soft computing and its practical implications. Soft computing is a multidisciplinary field that integrates different computational techniques to handle complex problems characterized by uncertainty, ambiguity, and imprecision. This section provides a brief introduction to soft computing, its motivation, and its distinguishing features. It also outlines the structure and objectives of the research article.

Components of Soft Computing

This section delves into the three main components of soft computing: fuzzy logic, neural networks, and evolutionary computation. It explains the underlying principles and methodologies of each component and highlights their strengths and limitations. Additionally, it discusses the potential benefits of combining these components to create hybrid systems that leverage their complementary characteristics. Fuzzy logic is a mathematical framework that deals with uncertainty and imprecision by allowing partial truth values. This section explores the fundamental concepts of fuzzy sets, fuzzy logic operations, and fuzzy inference systems. It also discusses fuzzy control systems and their applications in various domains such as industrial automation, robotics, and decision-making. Neural networks, inspired by the structure and function of the human brain, are computational models capable of learning and making predictions from data. This section provides an overview of neural network architectures, including feed forward, recurrent, and convolutional neural networks. It also discusses learning algorithms, such as back propagation, and explores the applications of neural networks in pattern recognition, image processing, and prediction tasks. Evolutionary computation techniques mimic the principles of natural evolution to solve optimization and search problems. This section covers the fundamentals of genetic algorithms, genetic programming, and evolutionary strategies. It explores their mechanisms of selection, crossover, and mutation, as well as their applications in optimization, data mining, and feature selection.

Hybrid Systems

The synergy between fuzzy logic, neural networks, and evolutionary computation has led to the development of hybrid systems that leverage the strengths of each component. This section discusses various approaches to combining these components, including fuzzy neural networks, neuro-fuzzy systems, and evolutionary neural networks. It highlights the advantages of hybrid systems and presents examples of their applications in real-world scenarios. Soft computing techniques find extensive applications across diverse domains. This section presents case studies and examples of soft computing applications in areas such as image processing, data mining, robotics, financial forecasting, and healthcare. It demonstrates the effectiveness of soft computing approaches in addressing complex problems that are difficult to solve using traditional methods. This section addresses the current challenges and limitations of soft computing techniques. It discusses issues related to interpretability, scalability, and the need for domain-specific expertise. Furthermore, it outlines potential future directions for soft computing research, including the integration of deep learning, explainable AI, and advancements in hardware for accelerating computations. The research article concludes by summarizing the key points discussed throughout the paper. It emphasizes the importance of soft computing techniques in dealing with complex problems characterized by uncertainty and imprecision. The article also highlights the wide-ranging applications of soft computing and the potential for further advancements in this field.

Commentary

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Data Mining: Unveiling Insights from Vast Information Networks

Ana Carolina Paula*

Department of Bioinformatics, Federal University of Santa Maria, Brazil

Corresponding author: Ana Carolina Paula, Department of Bioinformatics, Federal University of Santa Maria, Brazil, Email: anacarolina67@hotmail.com

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Introduction

Data mining is a powerful analytical technique that involves the extraction of valuable knowledge and patterns from large datasets. It encompasses a range of methodologies and algorithms designed to uncover hidden relationships, trends, and patterns within complex data structures. This research article provides an overview of data mining, its applications across various domains, key techniques and algorithms employed, and challenges associated with its implementation. Additionally, the article highlights the ethical considerations surrounding data mining and explores future directions for this rapidly evolving field. Data mining has emerged as a critical field in the era of big data. As organizations generate massive volumes of structured and unstructured data, the ability to extract actionable insights from these vast information networks becomes crucial. Data mining techniques enable businesses, researchers, and analysts to identify valuable patterns, trends, and associations that can drive informed decision-making and improve processes. This article delves into the fundamental concepts and methodologies of data mining.

Applications of Data Mining

Data mining finds applications in various industries and domains, including finance, healthcare, retail, telecommunications, and social media analysis. This section explores some of the key applications, such as fraud detection, customer segmentation, sentiment analysis, predictive maintenance, and personalized marketing. By leveraging data mining techniques, organizations can optimize operations, enhance customer experiences, and gain a competitive edge. Data mining encompasses a range of techniques that aid in the discovery of patterns and relationships within datasets. This section provides an overview of commonly employed techniques, including classification, clustering, association rule mining, anomaly detection, and regression analysis. Each technique is explained in detail, along with its specific use cases and algorithmic approaches. Data mining algorithms play a crucial role in extracting meaningful insights from datasets. This section discusses popular algorithms such as decision trees, k-means clustering, Apriori algorithm, support vector machines, and neural networks. Each algorithm is explained in terms of its underlying principles, advantages, and limitations. Real-world examples are provided to illustrate their practical applications. While data mining offers significant benefits, it also poses several challenges. This section highlights common challenges such as data quality, scalability, privacy concerns, and interpretability of results. The article discusses strategies to address these challenges and enhance the effectiveness and reliability of data mining processes.

Ethical Considerations

Data mining raises ethical concerns related to privacy, data security, and the potential for bias and discrimination. This section explores the ethical considerations associated with data mining and discusses the importance of implementing ethical guidelines and regulations. It emphasizes the need for transparency, informed consent, and responsible data usage to mitigate ethical risks. The field of data mining continues to evolve rapidly, driven by advancements in technology and the increasing availability of diverse datasets. This section discusses emerging trends, such as deep learning, natural language processing, and explainable AI, and their potential impact on data mining. It also explores the integration of data mining with other disciplines, such as Internet of Things (IoT) and blockchain, and envisions the future directions and possibilities for this dynamic field. Data mining plays a pivotal role in extracting valuable insights from large datasets, enabling organizations to make informed decisions and gain a competitive edge. This research article provided an overview of data mining, its applications, key techniques, and algorithms. It also highlighted the challenges and ethical considerations associated with data mining and discussed potential future directions. As the volume and complexity of data continue to grow, data mining will remain a crucial tool for uncovering hidden patterns and driving innovation in various domains.

Commentary

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Advancements in DNA Sequencing Technologies: Revolutionizing Genomics Research

Francisco Lucia*

Department of Molecular Medicine, University of Lisbon, Lisbon, Portugal

Corresponding author: Francisco Lucia, Department of Molecular Medicine, University of Lisbon, Lisbon, Portugal, Email: franciscolucia34@yahoo.com

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Introduction

DNA sequencing technologies have undergone significant advancements over the past few decades, transforming the field of genomics research. This research article provides a comprehensive overview of the different DNA sequencing technologies, highlighting their principles, applications, and recent developments. Starting with the Sanger sequencing method, we delve into the era of Next-Generation Sequencing (NGS) platforms and conclude with the emerging technologies that promise faster, more accurate and cost-effective DNA sequencing. Furthermore, we discuss the impact of these advancements on various fields, such as personalized medicine, agricultural genomics, and evolutionary biology. Through this article, we aim to provide researchers and enthusiasts with a comprehensive understanding of the current state of DNA sequencing technologies and their potential implications. DNA sequencing, the process of determining the precise order of nucleotides within a DNA molecule, has revolutionized the field of genomics research. The ability to sequence DNA has paved the way for breakthrough discoveries in various disciplines, including medicine, agriculture, and evolutionary biology. Over the years, DNA sequencing technologies have evolved from the labor-intensive Sanger sequencing method to the high-throughput Next-Generation Sequencing (NGS) platforms. These advancements have not only improved the speed and cost-effectiveness of DNA sequencing but have also enabled researchers to explore complex genomic landscapes.

Objectives

The objective of this research article is to provide a comprehensive overview of DNA sequencing technologies, focusing on their principles, applications, and recent developments. By discussing the advantages, limitations, and emerging trends in DNA sequencing, we aim to facilitate a better understanding of the current state of genomics research and its potential implications. Developed by Frederick Sanger in the 1970s, Sanger sequencing relies on the incorporation of chain-terminating dideoxynucleotides during DNA replication. This method involves multiple rounds of DNA synthesis, gel electrophoresis, and detection of fluorescently labeled fragments. The resulting sequence is reconstructed based on the pattern of labeled fragments. Sanger sequencing played a crucial role in the Human Genome Project and other early genomic studies. It offers high accuracy and long read lengths. However, it is time-consuming, expensive, and not suitable for large-scale sequencing projects. Sanger sequencing has been instrumental in identifying disease-causing mutations, studying genetic variation, and investigating evolutionary relationships. It continues to be used for targeted sequencing, validation of NGS results, and sequencing of individual genes. NGS platforms, introduced in the mid-2000s, revolutionized DNA sequencing by enabling parallel processing of millions of DNA fragments. These platforms employ a variety of sequencing-by-synthesis approaches, such as reversible terminators, pyrosequencing, and sequencing-by-ligation. NGS enables high-throughput sequencing at reduced cost and time. NGS has accelerated genomics research in diverse fields, including cancer genomics, infectious disease surveillance, metagenomics, and epigenomics. We highlight key studies that have leveraged NGS technologies to gain insights into complex biological processes. Although NGS offers exceptional throughput and cost-effectiveness, it is prone to various types of errors, including base-call errors and PCR amplification biases. Additionally, data analysis and storage pose significant challenges due to the vast amount of generated data.

Recent Developments in DNA Sequencing Technologies

Third-generation sequencing technologies, such as Pacific Biosciences (PacBio) and Oxford Nanopore Technologies, have emerged as promising alternatives to NGS. These platforms offer long read lengths, enabling the sequencing of contiguous genomic regions and complex structural variations. Single-molecule sequencing techniques aim to directly read the DNA sequence without amplification or the need for labeled nucleotides. This approach reduces biases introduced by PCR and provides real-time sequence information. Nanopore sequencing relies on passing DNA through nanopores and measuring the changes in electrical current as nucleotides pass through the pore. This label-free approach offers long reads and has been successfully applied in portable sequencing devices. We discuss the advantages and limitations of third-generation

and single-molecule sequencing technologies, including error rates, throughput, and cost. Furthermore, we explore ongoing research and developments aimed at improving the accuracy and scalability of these technologies. DNA sequencing has revolutionized the field of personalized medicine, enabling the identification of disease-causing mutations, prediction of drug responses, and development of targeted therapies. We discuss the applications of DNA sequencing in diagnostics, pharmacogenomics, and disease monitoring. DNA sequencing technologies have greatly advanced agricultural genomics by facilitating crop improvement, plant breeding, and pest management. We explore the applications of DNA sequencing in crop genomics, animal breeding, and microbial communities associated with agriculture. By enabling the comprehensive analysis of environmental DNA, sequencing technologies have revolutionized the field of environmental genomics. We highlight studies that have utilized DNA sequencing to study microbial diversity, track species distributions, and monitor environmental health. DNA sequencing has provided unprecedented insights into evolutionary processes and population genetics.

Perspective

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Gene Prediction: Methods, Challenges, and Future Perspectives

Qiannan Chen*

Department of Medicine, Zhejiang University, China

Corresponding author: Qiannan Chen, Department of Medicine, Zhejiang University, China Email: qiannanchen56@hotmail.com

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Introduction

Gene prediction, also known as gene finding or gene annotation, is a crucial step in deciphering the functional elements of a genome. Accurate identification and annotation of genes are fundamental for understanding the genetic basis of biological processes, disease mechanisms, and evolutionary relationships. This research article provides an overview of gene prediction methods, discusses the challenges associated with gene prediction, and explores future perspectives in the field. The article highlights the significance of advancing gene prediction techniques in the era of high-throughput sequencing technologies and emphasizes the need for integrating multiple data sources to enhance gene annotation accuracy. The advent of genome sequencing technologies has led to the generation of vast amounts of genomic data. Deciphering the functional elements within these genomes, such as genes, is essential for understanding the complexity of biological systems. Gene prediction algorithms aim to identify the locations and structures of genes based on sequence information and computational models.

Gene Prediction Methods

Ab initio methods use computational algorithms that rely solely on DNA sequence features to predict genes. These methods utilize statistical models, machine learning techniques, and comparative genomics approaches to infer gene structures. Prominent ab initio gene prediction tools include GeneMark, AUGUSTUS, and Glimmer. Comparative genomics approaches leverage evolutionary conservation to predict genes in a target genome by comparing it with reference genomes. This method identifies conserved regions across multiple species, inferring functional elements, including genes. Tools such as BLAST, GeneWise, and OrthoFinder are commonly employed in comparative genomics-based gene prediction. Transcriptome-based gene prediction integrates experimental data from RNA sequencing (RNA-seq) to improve gene annotation accuracy. This method aligns RNA-seq reads to the genome, allowing the identification of transcription start sites, alternative splicing events, and non-coding RNA genes. Tools like Cufflinks, StringTie, and Trinity are widely used for transcriptome-based gene prediction. The availability of fragmented or incomplete genomic data poses challenges in accurately predicting genes, particularly in non-model organisms or poorly sequenced genomes. Integration of multiple data sources, such as transcriptomic and proteomic data, can help address this issue. Alternative splicing generates multiple transcript isoforms from a single gene, significantly increasing transcriptome complexity. Identifying and accurately annotating gene isoforms remain a major challenge in gene prediction, requiring advanced algorithms and comprehensive transcriptomic datasets.

Identification of Non-Coding RNA Genes

Non-coding RNA genes play crucial regulatory roles but are often missed by traditional gene prediction methods that primarily focus on protein-coding genes. Developing specialized tools and pipelines to predict non-coding RNA genes is an active area of research. Advancements in high-throughput sequencing technologies enable the generation of various omics data, including genomics, transcriptomics, proteomics, and epigenomics. Integrating multi-omics data can enhance gene prediction accuracy, providing a more comprehensive understanding of gene functions. Deep learning techniques, such as Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs), have shown promising results in various bioinformatics applications. Applying deep learning algorithms to gene prediction can potentially improve accuracy and handle complex genomic features. Long-read sequencing technologies, such as PacBio and Oxford Nanopore sequencing, offer improved read lengths and can span through repetitive regions, aiding in the accurate prediction of complex gene structures. Integrating long-read sequencing data with other gene prediction methods can enhance annotation quality. Gene prediction plays a pivotal role in genome annotation and understanding the functional elements within genomes. Various gene prediction methods, including ab initio, comparative genomics, and transcriptome-based approaches, have been developed to tackle this task. However, challenges such as incomplete data, alternative splicing, and non-coding RNA genes persist. Future advancements in integrating multi-omics data, deep learning algorithms, and long-read sequencing technologies hold great promise for improving gene prediction accuracy and expanding our knowledge of the complex genomic landscape.

Perspective

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Oncogenomics: Unveiling the Genomic Landscape of Cancer

Abdul Kausar*

Department of Bioinformatics, Iqra University, Islamabad, Pakistan

Corresponding author: Abdul Kausar, Department of Bioinformatics, Iqra University, Islamabad, Pakistan, Email: abdulkausar67@hotmail.com

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Introduction

Oncogenomics, a rapidly advancing field, aims to elucidate the complex interplay between genetic alterations and cancer development. This research article provides an in-depth exploration of oncogenomics, its methodologies, and its impact on cancer diagnosis, treatment, and personalized medicine. By analyzing large-scale genomic data, researchers have identified critical oncogenes, tumor suppressor genes, and genomic alterations that drive cancer progression. Moreover, the integration of oncogenomics into clinical practice has revolutionized cancer management, enabling targeted therapies and improved patient outcomes. This article highlights key breakthroughs in oncogenomics, discusses challenges, and explores future prospects, ultimately underscoring the significant role of genomics in advancing cancer research and precision medicine. Cancer is a complex disease characterized by aberrant genetic alterations that disrupt cellular processes and lead to uncontrolled cell growth. Oncogenomics, a subfield of genomics, focuses on understanding the genetic drivers and molecular mechanisms underlying cancer development. By deciphering the genomic landscape of tumors, oncogenomics offers insights into the origins of cancer, its progression, and potential therapeutic targets.

Methodologies in Oncogenomics

Oncogenomics employs various methodologies to investigate the genetic alterations associated with cancer. These include high-throughput sequencing technologies, such as Whole-Genome Sequencing (WGS), Whole-Exome Sequencing (WES), and transcriptome sequencing. Additionally, techniques like array Comparative Genomic Hybridization (aCGH) and Single-Nucleotide Polymorphism (SNP) arrays enable the identification of genomic copy number variations and somatic mutations. These methods collectively provide comprehensive genomic profiles of cancer, facilitating the discovery of oncogenes and tumor suppressor genes. Oncogenomics studies have yielded significant discoveries that have transformed our understanding of cancer biology. For instance, the identification of oncogenes, such as BRAF, EGFR, and HER2, has revolutionized targeted therapy approaches. These oncogenes, when mutated or amplified, drive tumorigenesis and represent attractive therapeutic targets. Furthermore, the discovery of tumor suppressor genes, including TP53, PTEN, and BRCA1/2, has shed light on the critical role of genomic stability and DNA repair mechanisms in preventing cancer development. Genomic alterations, such as point mutations, chromosomal rearrangements, gene fusions, and copy number variations, contribute to the initiation and progression of cancer. Oncogenomics studies have identified recurrent genomic alterations across different cancer types, providing insights into their functional significance and potential therapeutic implications. Additionally, genomic profiling has facilitated the classification of tumors into distinct subtypes, guiding treatment decisions and predicting patient outcomes.

Translating Oncogenomics into Clinical Practice

The integration of oncogenomics into clinical practice has transformed cancer management and personalized medicine. Molecular profiling of tumors allows for the identification of actionable genomic alterations, enabling the selection of targeted therapies and improving treatment outcomes. Liquid biopsies, a non-invasive method for detecting circulating tumor DNA, have also emerged as a valuable tool for monitoring treatment response and detecting minimal residual disease. Despite significant progress, several challenges remain in the field of oncogenomics. The interpretation of genomic data, the complexity of tumor heterogeneity, and the need for robust bioinformatics tools pose ongoing challenges. Furthermore, the ethical considerations surrounding genomic testing and the integration of oncogenomics in resource-limited settings require careful navigation. Nonetheless, ongoing advancements in technology, bioinformatics, and collaborative research efforts hold promise for addressing these challenges and further advancing oncogenomics. Oncogenomics has revolutionized our understanding of cancer by uncovering the intricate genomic alterations that drive tumorigenesis. By integrating oncogenomics into clinical practice, we can enhance cancer diagnosis, treatment selection, and patient outcomes. As we continue to explore the genomic landscape of cancer, oncogenomics will play a pivotal role in the development of personalized therapies, improving the lives of individuals affected by this devastating disease.

Opinion Article

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Protein Microarrays: A Comprehensive Analysis and Future Perspectives

Simone Scheper*

Department of Technical Chemistry and Biomolecular Drug Center, Leibniz University of Hannover Hanover, Germany

Corresponding author: Simone Scheper, Department of Technical Chemistry and Biomolecular Drug Center, Leibniz University of Hannover Hanover, Germany, Email: simonescheper67@yahoo.com

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Introduction

Protein microarrays have emerged as a powerful tool for high-throughput protein analysis and have revolutionized the field of proteomics. This research article aims to provide a comprehensive analysis of protein microarrays, including their principles, fabrication methods, applications, advantages, and limitations. Additionally, we discuss recent advancements and future perspectives in the field of protein microarrays. The information presented in this article will aid researchers in understanding the potential of protein microarrays and inspire further innovation in this rapidly evolving field. Protein microarrays have gained significant attention in the field of proteomics due to their ability to simultaneously analyze thousands of proteins in a high-throughput manner. This section provides a brief overview of the importance of protein analysis and introduces the concept of protein microarrays as a promising technology to address the challenges associated with traditional protein analysis techniques. This section describes the underlying principles of protein microarrays. It covers the two main types of protein microarrays: analytical microarrays and functional protein microarrays. The working principles of these microarrays, including protein immobilization strategies, detection methods, and data analysis, are discussed in detail.

Applications and fabrication methods of Protein Microarrays

Various fabrication methods are employed to create protein microarrays, each with its advantages and limitations. This section presents an overview of commonly used fabrication techniques, including inkjet printing, contact printing, and in situ synthesis. The advantages, challenges, and recent advancements in each method are discussed. Protein microarrays have found numerous applications in various research areas, including protein-protein interactions, antibody profiling, drug discovery, diagnostics, and systems biology. This section highlights the diverse applications of protein microarrays and provides examples of their utility in elucidating biological mechanisms and identifying disease biomarkers. Protein microarrays offer several advantages over traditional protein analysis techniques. This section discusses the key advantages of protein microarrays, such as high-throughput analysis, multiplexing capability, reduced sample consumption, and cost-effectiveness. Furthermore, the potential for protein microarrays to enable personalized medicine and precision diagnostics is explored. Despite their numerous advantages, protein microarrays face certain limitations and challenges that need to be addressed. This section outlines the limitations of protein microarrays, including issues related to protein stability, reproducibility, and standardization. Moreover, challenges such as data analysis, quality control, and integration with other omics technologies are discussed.

Recent Advancements and Future Perspectives

This section focuses on the recent advancements in protein microarray technology, including advancements in fabrication techniques, detection methods, and data analysis approaches. Additionally, it presents future perspectives in the field of protein microarrays, such as the integration of nanotechnology, single-cell analysis, and the use of machine learning algorithms to enhance data interpretation and predictive modeling. Protein microarrays have emerged as a powerful tool in proteomics research, enabling high-throughput protein analysis and offering new insights into biological processes. This article provides a comprehensive analysis of protein microarrays, highlighting their principles, fabrication methods, applications, advantages, and limitations. The recent advancements and future perspectives discussed in this article underscore the immense potential of protein microarrays and their promising role in advancing personalized medicine and precision diagnostics.

Commentary

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Biomedical Text Mining: Advancements, Applications, and Challenges

Ramesh Babu Ramiya*

Department of Biotechnology Engineering, Ben-Gurion University of the Negev, Beer-Sheva, Israel

Corresponding author: Ramesh Babu Ramiya, Department of Biotechnology Engineering, Ben-Gurion University of the Negev, Beer-Sheva, Israel, Email: ramiyaramesh89@hotmail.com

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Introduction

Biomedical research generates an enormous amount of textual data, including scientific articles, clinical reports, and electronic health records. Extracting relevant information from these vast amounts of unstructured data is a challenging task. Biomedical text mining, a subfield of natural language processing, has emerged as a powerful tool to tackle this challenge. This research article provides an overview of biomedical text mining, including its advancements, applications, and the challenges that researchers encounter. We discuss various techniques employed in biomedical text mining, such as named entity recognition, relationship extraction, and text classification. Furthermore, we explore the diverse applications of biomedical text mining, including literature curation, drug discovery, clinical decision support, and personalized medicine. Finally, we address the challenges associated with biomedical text mining, such as data heterogeneity, domain-specific language, and the need for effective validation and evaluation methods. The article concludes by highlighting the potential future directions in biomedical text mining research.

Techniques in Biomedical Text Mining

Biomedical research generates an immense volume of textual data, which holds valuable information for improving healthcare outcomes. However, extracting meaningful insights from this vast corpus of unstructured text poses significant challenges. Biomedical text mining, an interdisciplinary field combining natural language processing, machine learning, and domain expertise, aims to extract and analyze information from biomedical texts. In this section, we provide an introduction to biomedical text mining and outline the objectives of this research article. This section delves into the techniques employed in biomedical text mining. We discuss the preprocessing steps involved in handling biomedical text data, including tokenization, sentence segmentation, and part-of-speech tagging. Furthermore, we explore key techniques such as named entity recognition, relationship extraction, and text classification, highlighting their significance in extracting valuable information from biomedical texts. Biomedical text mining finds diverse applications across the healthcare domain. In this section, we discuss several prominent applications, including literature curation, where text mining aids in the extraction of relevant information from scientific articles to create structured knowledge bases. We also explore the role of text mining in drug discovery, clinical decision support systems, and personalized medicine, highlighting the potential impact of biomedical text mining in each of these areas.

Challenges in Biomedical Text Mining

Despite its immense potential, biomedical text mining encounters several challenges. In this section, we discuss these challenges, such as data heterogeneity, the presence of domain-specific language, and the need for effective validation and evaluation methods. We also address the ethical considerations related to patient privacy and data protection in biomedical text mining. This section highlights potential future directions for biomedical text mining research. We explore emerging technologies such as deep learning and knowledge graph integration that have the potential to enhance the performance and capabilities of biomedical text mining systems. Additionally, we discuss the importance of interdisciplinary collaborations and the integration of text mining with other biomedical data sources. In this section, we summarize the key points discussed throughout the research article. We emphasize the significance of biomedical text mining in extracting valuable information from the vast amount of textual data generated in biomedical research. We also highlight the potential impact of biomedical text mining in improving healthcare outcomes and call for further research in this rapidly evolving field.

Commentary

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Bioimage Informatics: Advancing Image Analysis and Data Interpretation in Biological Research

Suganti Sheila*

Department of Bioscience and Biotechnology, Malaysia Genome Institute, Kajang, Malaysia

Corresponding author: Suganti Sheila, Department of Bioscience and Biotechnology, Malaysia Genome Institute, Kajang, Malaysia, Email: sugantishiela45@hotmail.com

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Introduction

Bioimage informatics is an interdisciplinary field that combines biology, computer science, and image analysis techniques to extract meaningful information from biological images. With the advent of advanced imaging technologies, such as confocal microscopy, electron microscopy, and super-resolution microscopy, the amount and complexity of imaging data generated in biological research have increased significantly. The field of bioimage informatics has emerged to address the challenges associated with analyzing, visualizing, and interpreting these vast datasets. This research article provides an overview of bioimage informatics, its applications in biological research, and the techniques and algorithms used for image analysis. Bioimage informatics plays a crucial role in modern biological research by providing tools and methods to extract quantitative information from biological images. It encompasses various aspects, including image preprocessing, image segmentation, feature extraction, image registration, and data visualization. This article aims to highlight the significance of bioimage informatics in advancing biological research and shed light on the methodologies employed in this field.

Machine Learning in Bioimage Informatics

Image preprocessing is a vital step in bioimage informatics, involving noise reduction, image enhancement, and background subtraction. Techniques like filtering, deconvolution, and normalization are commonly employed to improve image quality and facilitate accurate analysis. Image segmentation involves partitioning an image into distinct regions to identify and analyze individual objects or structures within the image. Segmentation methods can be based on intensity thresholds, edge detection, region growing, or machine learning algorithms. The choice of segmentation technique depends on the characteristics of the biological sample and the desired level of accuracy. Feature extraction aims to quantify specific properties or characteristics of biological objects within an image. Various features, such as shape, texture, intensity, and spatial relationships, can be extracted using techniques like morphological operations, Haralick features, and wavelet transforms. These extracted features provide valuable information for subsequent analysis and classification. Image registration involves aligning multiple images taken at different times or from different modalities to enable comparisons and tracking of biological structures. Registration techniques can be based on landmark matching, intensity-based methods, or feature-based methods. Accurate image registration facilitates longitudinal studies and multi-modal analysis. Machine learning algorithms have revolutionized bioimage informatics by enabling automated analysis and classification of biological images. Supervised and unsupervised machine learning techniques, such as Convolutional Neural Networks (CNNs) and clustering algorithms, have been successfully applied for tasks like object detection, cell classification, and image annotation.

Data Visualization and Analysis

Bioimage informatics generates vast amounts of data that require effective visualization and analysis techniques. Visualization tools, such as scatter plots, heatmaps, and 3D rendering, enable researchers to explore and interpret complex image datasets. Furthermore, data analysis techniques, including statistical analysis, data mining, and network analysis, provide insights into the relationships and patterns present within the data. Bioimage informatics finds applications in various fields of biological research, including cell biology, neuroscience, developmental biology, and pathology. It facilitates investigations into cell morphology, subcellular localization, protein-protein interactions, and disease mechanisms. Additionally, bioimage informatics contributes to high-throughput screening, drug discovery, and personalized medicine. Despite significant advancements, bioimage informatics still faces challenges, such as handling large-scale datasets, developing robust algorithms, and integrating heterogeneous data sources. The future of bioimage informatics lies in the development of more sophisticated machine learning approaches, deep learning architectures, and data-driven models.

Perspective

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Flow Cytometry Bioinformatics: Advancements and Applications

Animesh Chandra*

Department of Bioinformatics, Green University of Bangladesh, Dhaka, Bangladesh

Corresponding author: Animesh Chandra, Department of Bioinformatics, Green University of Bangladesh, Dhaka, Bangladesh, Email: animeshchandra78@gmail.com

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Introduction

Flow cytometry is a powerful technique that enables simultaneous analysis of multiple parameters at the single-cell level. Over the years, advancements in flow cytometry instrumentation and the development of sophisticated analytical methods have significantly enhanced the potential of flow cytometry in various fields of research. However, the analysis of flow cytometry data requires specialized bioinformatics tools and algorithms to extract meaningful information from the vast amount of data generated. This research article provides an overview of flow cytometry bioinformatics, including data preprocessing, clustering, visualization, and machine learning techniques. Additionally, we discuss the emerging applications of flow cytometry bioinformatics in immunology, cancer research, and drug discovery. The article concludes by highlighting future directions and challenges in this rapidly evolving field. Flow cytometry is a widely used technique for characterizing and analyzing heterogeneous populations of cells based on their physical and biochemical properties. It provides high-throughput, quantitative measurements of cellular features such as surface markers, intracellular proteins, and DNA content. However, the analysis of flow cytometry data is complex due to the multidimensional nature of the data and the presence of noise and variability. Bioinformatics approaches play a crucial role in unraveling the biological insights hidden within flow cytometry data.

Flow Cytometry Data Preprocessing

Data preprocessing is a critical step in flow cytometry analysis that involves quality control, compensation, normalization, and dimensionality reduction. This section discusses various preprocessing techniques, including outlier detection, gating strategies, compensation algorithms, and normalization methods, along with their impact on downstream analysis. Clustering algorithms are widely used in flow cytometry bioinformatics to identify cell subsets and reveal population heterogeneity. This section explores popular clustering techniques, including hierarchical clustering, k-means clustering, and density-based clustering, highlighting their strengths and limitations. Moreover, advanced clustering approaches such as flowSOM, PhenoGraph, and t-SNE-based methods are discussed, which facilitate the discovery of rare cell populations and reveal cellular interactions. Effective visualization of flow cytometry data is crucial for exploratory analysis and result interpretation. This section presents visualization methods, such as heatmaps, scatter plots, and dimensionality reduction techniques like Principal Component Analysis (PCA) and Uniform Manifold Approximation and Projection (UMAP). Additionally, the integration of visualization with gating strategies is discussed, enabling the identification of relevant cell populations.

Machine Learning in Flow Cytometry Bioinformatics

Machine learning techniques have revolutionized flow cytometry data analysis by enabling automated classification, prediction, and feature selection. This section explores the application of machine learning algorithms, including decision trees, support vector machines, random forests, and deep learning approaches, in flow cytometry data analysis. Furthermore, transfer learning and ensemble methods are discussed, showcasing their potential for improving classification accuracy and robustness. Flow cytometry bioinformatics has found widespread applications in various fields, including immunology, cancer research, and drug discovery. This section provides examples of how flow cytometry bioinformatics has contributed to understanding immune cell populations, identifying biomarkers for disease diagnosis, and optimizing drug development processes. The rapid advancement of flow cytometry bioinformatics presents exciting opportunities and challenges. This section highlights future directions such as the integration of multi-omics data, single-cell RNA sequencing, and the development of standardized data analysis pipelines. Additionally, challenges related to data standardization, reproducibility, and the need for user-friendly software tools are discussed. Flow cytometry bioinformatics is an indispensable field that bridges the gap between flow cytometry experimentation and data analysis. This article provides an overview of the key components of flow cytometry bioinformatics

Research Article

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Comparison of Clinico-Epidemiological Profile in Hepatitis C Patients with and without Spontaneous Bacterial Peritonitis

Sher Alam Montaqee[1], Rehmatullah[2], Mujahid Raza[3], Amina Zulfiqar[4] and Saleem Abbasi[5*]

[1]Department of Gastroenterology, Pakistan Institute of Medical Sciences, Islamabad, Pakistan

[2]Department of Cardiology, Pakistan Institute of Medical Sciences, Islamabad, Pakistan

[3]Department of Radiology, Pakistan Institute of Medical Sciences, Islamabad, Pakistan

[4]Department of Medicine, Federal Government Polyclinic, Islamabad, Pakistan

[5]Department of Epidemiology, Pakistan Institute of Medical Sciences, Islamabad, Pakistan

Corresponding author: Saleem Abbasi, Department of Epidemiology, Pakistan Institute of Medical Sciences, Islamabad, Pakistan, E-mail: saleemsw@hotmail.com

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Abstract

Introduction: Chronic HCV infection is a serious public health concern worldwide. In Pakistan, its prevalence has been reported as 4.7%. An estimated 20%-25% cases of hepatitis C results into cirrhosis. The collection of free fluid in peritoneal cavity is known as ascites and an important complication of advanced cirrhosis that sometimes gets complicated by Spontaneous Bacterial Peritonitis (SBP). Present study was designed to compare the clinico-epidemiological profile in hepatitis C patients with and without SBP.

Methodology: A cross sectional comparative study was conducted in the Department of Gastroenterology, Pakistan Institute of Medical Sciences, Islamabad. Study duration was one year from January 2020 to December 2020. Adult patients 18 to 65 years of age and both genders with established diagnoses of liver cirrhosis secondary to hepatitis C and those having moderate to severe ascites were included. The study was approved by hospital ethics committee and written informed consent was taken. SPSS version 21.0 was utilized to enter and analyze data.

Results: Of total 73 cases, 38 (52.05%) were male with male/female ratio of 1.1:1. The mean age was 56.45 ± 9.71 years. There were 30 (41.1%) patients with positive for SBP. In SBP group major clinical presentations were jaundice 27 (90%), fever 24 (80.0%), abdominal pain and tenderness 22 (73.3%), tachycardia 13 (43.3%), hepatic encephalopathy 11 (36.7%) and HRS in 8 (26.7%). It was noted that in SBP group, fever, abdominal pain and tenderness were significantly greater than in the non-SBP group (P<0.05).

Conclusion: SBP was found in significant percentage of patients who had HCV related CLD. Fever, abdominal pain and tenderness were significantly higher in SBP group.

Keywords: Hepatitis C; Clinical features; CLD; Spontaneous bacterial peritonitis

Introduction

Acute/chronic hepatitis, liver cirrhosis and hepatocellular carcinoma can be caused by Hepatitis C Virus (HCV). Chronic HCV infection is becoming a serious public health concern worldwide and the risk of progressive CLD is expected to rise considerably in the coming decades. The prevalence of chronic HCV infection varies worldwide and figures between 0.1% to 12% have been reported [1].

In Pakistan, the Hepatitis C Virus (anti HCV) prevalence was reported 4.7% in a "National General Population Survey" by WHO conducted from 2007 to 2008. The sero-prevalence of hepatitis C ranges from 2.2% to 13.5% in various regions of Pakistan during the last 5 years. The highest prevalence of HCV reported from Lahore and Jamshoro/Mardan, 13% and 9% respectively [2]. An estimated 20%-25% cases of hepatitis C results into cirrhosis, which is characterized by diffuse destruction and regeneration of hepatic parenchymal cells with ultimate disorganization of lobular architecture. The collection of free fluid in peritoneal cavity is known as ascites and an important complication of advanced cirrhosis that sometimes gets complicated by Spontaneous Bacterial Peritonitis (SBP).

SBP, as an entity, was first documented by Conn in 1964. It is defined as an abrupt beginning of acute bacterial peritonitis irrespective of any 4 seemingly course of infection in the abdomen. High rates of mortality 20%-40% have been reported due to CLD with ascites complicated by SBP [3]. The exact etiology of SBP is not known, though bacterial translocation is considered as main cause. The reported prevalence of SBP's among cirrhotic hospitalized cases with ascites is about 10% to 30% [4]. The prognosis is considerably better if diagnosis is made

earlier and prompt treatment is initiated. The culture is positive and if ascitic fluid has PMN count about ≥ 250 cells/mm^3 and there is no secondary cause of infection, then a diagnosis of SBP is confirmed. Approximately 10%-60% of patients with clinical presentation of SBP have negative ascitic fluid cultures [5]. An empiric use of antibiotic therapy is usually recommended in such cases [6].

Ceftriaxone, a third-generation cephalosporin, has been reported as effective therapy against almost all organisms isolated from SBP patients except bacteriodes fragilis and enterococcus faecalis, which are rarely predisposing organisms [7]. Prophylactic antibiotics (Norfloxacin 400 mg BD) are recommended for patients who have high risk of developing SBP like patients with upper GIT bleed. Norfloxacin 400 mg OD is also being recommended in patients with prior history of SBP. The definite treatment of SBP is liver transplantation and antibiotics are given until the surgery. Long-term use of antibiotics is recommended for patients in whom transplantation is contraindicated [5].

Present study was designed to compare the clinic-epidemiological profile in hepatitis C patients with and without SBP. Limited data on this particular subject was available at both local and national level. It is expected that data collected will help the physicians in the better management of these patients that will eventually reduce the related morbidity and mortality.

Methodology

This cross sectional comparative study was conducted in the Department of Gastroenterology, Pakistan Institute of Medical Sciences, Islamabad. Study duration was one year from January 2020 to December 2020. Adult patients 18 to 65 years of age and both genders with established diagnoses of liver cirrhosis secondary to hepatitis C and those having moderate-severe ascites (diagnosed clinically and on ultrasonography) were included in the study. The patients with a history of antibiotics use in past 10 days, patients with history of hypersensitivity to penicillin or cephalosporins, pregnant women and those with other chronic medical conditions like diabetes mellitus, hypertension and ischemic heart disease were excluded from the study.

The study was approved by hospital ethics committee at Shaheed Zulfiqar Ali Bhutto Medical University (SZABMU), Pakistan Institute of Medical Sciences (PIMS), Islamabad. Patients, who were admitted from the OPD and emergency department for various complications of portal hypertension and cirrhosis, were selected and enrolled who meet the study criteria.

The study information was gathered on a specifically designed structured proforma. History and clinical data regarding abdominal pain/tenderness, jaundice, hepatic encephalopathy, hematemesis, melena and fever were obtained. Venous blood samples were drawn for blood count, serum bilirubin, serum albumin, prothrombin time. Ascitic fluid was tapped and analyzed in the laboratory at PIMS hospital for cell count, polymorph nuclear cells and protein. The patients were classified as a positive case of SBP on the basis of these investigations. Child Pugh class of the patients was determined on the basis of ascitic fluid, hepatic encephalopathy, serum bilirubin, serum albumin and prothrombin time to evaluate the severity of chronic liver disease.

The sample size was calculated using a sample calculator using confidence level of 95%, anticipated population proportion with SBP of 37.1% and assumed precision of 12% [4]. The study sample size was 73 patients who were enrolled using non-probability based consecutive sampling technique. SPSS version 21.0 was utilized to enter and analyze the collected data. Quantitative variables of the study were age, ascitic fluid analysis, serum bilirubin, serum albumin, prothrombin time were presented as mean and standard deviation. The categorical variables of the study were gender, Child Pugh classification, SBP, abdominal pain/tenderness, jaundice, hepatic encephalopathy, hematemesis, melena, fever and study outcome were analyzed as frequency and percentages. The clinical manifestations like fever, jaundice, abdominal distension/ascites, hepatic encephalopathy, melena/hematemesis, hypotension, abdominal pain and nausea/vomiting, *etc*. and epidemiological profile like frequency of SBP were compared among hepatitis C patients with or without SBP using chi-square test for categorical and student t-test for quantitative variables. A p-value of <0.05 considered significant.

The study outcomes were judged in terms of clinical and epidemiological presentation of hepatitis C patients with or without SBP.

Results

Out of the total 73 study patients, 38 (52.05%) were male and 35 (47.95%) were females, the male/female ratio was 1.1:1 and the mean age was 56.45 ± 9.71 years with established diagnoses of liver cirrhosis secondary to hepatitis C. There were 30 (41.1%) patients having positive for SBP as per study operational definition. In the SBP group, 15 (50%) cases were in CTP class C, 13 (43.3%) in CTP class B and 2 (6.7%) in CTP class A **(Table 1)**.

Table 1: Demographic characteristics in the study (n=73).

	No of cases	**%Age**
Gender		
Male	38	52.0%
Female	35	48.0%

Age (years)		
Mean ± SD	56.45 ± 9.71	
Type of peritonitis		
SBP	30	41.1%
Non-SBP	43	58.8%

The biochemical parameters in both groups are tabulated in **Table 2**. All the SBP's cases had the mean MELD score of 20.8 ± 8.6 on admission. The mean ascitic TLC was 2310.5 ± 2766.7/ cm^3, the mean neutrophils counts was 1706.8 ± 2318.6/cm^3 the mean lymphocytes count was 710.4 ± 703.5/cm^3 and the mean LDH concentration was 257.4± 157.7 IU/dL which were considerably raised in SBP group (P<0.05). No other significant difference noted. The reason for higher ascitic total protein in Non SBP group then SBP group is the higher number of CTP class C cases (62.8% *vs.* 50.0%) respectively **(Table 2).**

Table 2: Baseline MELD score and biochemical parameters in both groups.

	SBP (n=30) (mean ± SD)	**Non-SBP(n=43)** (mean ± SD)	
Meld Score	20.8 ± 8.6	21.4 ± 7.6	0.736
Ascitic TLC (/uL)	2310.5 ± 2766.7	231.1 ± 267.5	<0.001
Lymphocytes (/uL)	710.4 ± 703.5	160.1 ± 214.7	<0.001
Ascitic neutrophils (/uL)	1706.8 ± 2318.6	69.6 ± 69.2	<0.001
Peripheral TLC (/uL)	10436.7 ± 7431.6	7731.4 ± 4228.1	0.052
Ascitic protein (g/dL)	1.4 ± 1.1	0.8 ± 0.5	0.004
Ascitic glucose (mg/dL)	109.1 ± 58.8	111.6 ± 56.1	0.565
Ascitic LDH (IU/dL)	257.4 ± 157.7	105.3 ± 65.6	<0.001

The study results showed that in SBP group major clinical presentations were jaundice 27 (90%), fever 24 (80.0%), abdominal pain and tenderness 22 (73.3%), tachycardia 13 (43.3%), hepatic encephalopathy 11 (36.7%) and HRS in 8 (26.7%). Comparatively, in non SBP group major clinical presentations were jaundice 35 (81.4%), hepatic encephalopathy 29(67.4%), abdominal pain and tenderness 23 (53.5%), fever 17(39.5%), tachycardia 18(43.3%) and HRS 10(23.3%). It was noted that in SBP group, fever, abdominal pain and tenderness were significantly greater than in the non-SBP group (P<0.05). No other significant difference was noted in clinical features of patients **(Table 3)**.

Table 3: Clinical presentation pattern in both groups.

	Groups		**p-value**
	SBP (n=30)	**Non-SBP (n=43)**	
Abdominal pain tenderness	22 (73.3%)	23 (53.5%)	0.086
Hematemesis melena	3 (10.0%)	8 (18.6%)	0.312
Abdominal distension ascities	30 (100.0%)	43 (100.0%)	
Jaundice	27 (90.0%)	35 (81.4%)	0.312
Hypotension	1 (3.3%)	0 (0.0%)	0.228
Hepatic encephalopathy	11 (36.7%)	29 (67.4%)	0.009
Fever	24 (80.0%)	17 (39.5%)	<0.001

Tachycardia	13 (43.3%)	18 (43.3%)	
HRS	8 (26.7%)	10 (23.3%)	0.592
Chills	1 (3.3%)	3 (6.9%)	0.501

Discussion

Spontaneous Bacterial Peritonitis (SBP) is considered as a frequent complication in cirrhotic and ascitic patients, it is a highly fatal complication. This study was planned to relate the clinic-epidemiological profile in hepatitis C patients with and without SBP, because limited data is available at local and national level regarding these patients.

In this study a total of 41.1% patients were positive for SBP while remaining were negative. Previous local data also revealed a similarly high incidence of SBP with variable reports. A study from KP witnessed 25.1% SBP patients [8]. Another study from Ghana witnessed 21.4% cases of SBP [9]. Similar, data has been witnessed in this region as well. A study from Bulgharia reported SBP in almost 14.9% of their patients [10]. Another study from Saudi Arabia reported 29.6% patients diagnosed with SBP [11]. Another study reported in-hospital SBP frequency of 8% to 27.0% [12]. Other reports from western world show a significantly lower frequency of SBP and most of the data ranges between 7% to 30% cases per annum [13]. Jarcuska, et al. assessed incidence of SBP, in 169 cirrhotic patients and witnessed 16.0% patients with SBP [14]. These variable report on SBP incidence show a growing trend in regions and countries where hepatitis is more common and resultantly chronic liver conditions are more frequent.

In this study, though no significant difference was witnessed regarding gender, Child Pugh classification and mean MELD score between SBP and non-SBP patients. But the frequency of SBP was high in the CTP class C in SBP group. The incidence rate of SBP is not equal in the CLD patients in different region of the world.

In the current study the frequency of fever, abdominal pain and tenderness and tachycardia were significantly higher in SBP group and the frequency of hepatic encephalopathy was substantially elevated in non-SBP group ($P<0.05$). The reason of high PSE in non-SBP group is the higher number of PSE's patients which were compared to the SBP Group. No other significant difference was noted ($P>0.05$).

Comparatively, different studies reported various frequencies of clinical features. A study from Peshawar reported abdominal pain, tenderness, fever, jaundice and hepatic encephalopathy as significant clinical manifestations of SBP [15]. In a study conducted in Abbottabad, abdominal tenderness was present in 80.7% and abdominal pain in 73.1% and splenomegaly in 76.9% of SBP patients [16]. These local studies have witnessed higher frequency of abdominal pain, tenderness, fever, jaundice and hepatic encephalopathy. The study from KP has documented tenderness, jaundice, abdominal pain, hepatic encephalopathy and fever in SBP patients [8]. Western studies have reported fever in 67.5% to 75% patients, abdominal pain in 51.5% and abdominal tenderness in 53% of SBP patients [17,18]. The classical features of patients with CLD and SBP are quite similar; however, their proportion may vary from region to region and community to community.

In the present study the investigational findings showed that mean ascitic TLC, lymphocytes, neutrophils and LDH was considerably higher in SBP group than those in non-SBP group ($P<0.05$). The study results are comparable with other studies conducted either locally or internationally [19]. In a case control study by Talaat, et al. conducted in 45 ascitic patients secondary to cirrhosis and SBP, had considerably high PMN neutrophil count and LDH level, whereas total proteins, glucose and albumin level markedly decreased in SBP group than non SBP group [20]. The corner stone for the SBP diagnosis was high ascitic fluid neutrophil count. On the other hand, the risk factors for SBP were low protein and albumin concentration in the ascitic fluid, while ascitic fluid glucose could be consumed by bacteria during uncontrolled infection. Another study by Danulescu, et al. reported that bilirubin and creatinine were considerably raised in SBP patients, and total protein, albumin and prothrombin time level decreased significantly in patients with SBP, hepatic impairment correlated with the degree of biochemical parameters and may be considered risk factors for SBP [21].

The study by Schwabl, et al. assessed and found independent risk factors of Child-Pugh stage C, ascitic fluid PMN count and decreased serum sodium for development of SBP [22]. It is well known that in patients with chronic liver disease and SBP the biochemical profile becomes very compromised and based on these results, the resultant mortality may be assumed. Evidence suggests that at least 50% of the patients with SBP do not survive and die eventually and recurrence of SBP is also very high and then resultant mortality is similar after a second episode of the condition [17,18].

Older studies have even witnessed 80% to 100% lethality associated with SBP, which was mainly due to poor treatment opportunities and dearth of efficacious antibiotics. However, the recent trials have reported quite better outcomes and witnessed 20%-40% mortality due to timely diagnosis and treatment [23]. The SBP is diagnosed on the basis of cell count of PMN's neutrophils in the ascitic fluid. Diagnostic paracentesis should also be conducted together with PMN's count in ascites among all cases when they admit in the hospital or when patients condition become worsen in advance cirrhosis or sudden increase in ascites. If the number and sum of PMN's in ascitic fluid are "≥ 250 cells/ml", a positive culture report has no significance, SBP is diagnosed and treatment should be initiated [24]. This suggests that the continuous monitoring of patients with chronic liver diseases, cirrhosis and ascites may prove as a

preventive measure due to timely diagnosis and management of severe cases such as SBP.

The current study has many advantages, firstly, this is one first of its type in the local settings. The frequency of hepatitis and chronic liver diseases is on the rise in the country and region, evidence regarding its repercussions in terms of ascites and SBP are an added advantage for the management and diagnosis of these patients and healthcare workers alike.

Conclusion

SBP was found in significant percentage of patients who had HCV related CLD in this study. Major clinical presentation was similar in SBP and non-SBP patients. However, fever, abdominal pain and tenderness were significantly higher in SBP group while hepatic encephalopathy was the major presentation in non-SBP group.

It is recommended that all cirrhotic patients with detectable ascites should undergo for routine ascitic examination to rule out SBP.

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Commentary

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Regenerative Developmental Hurtfulness Screening Test

Haemin Jim*

Department of Botany, University of Twente, Enschede, Netherlands

Corresponding author: Haemin Jim, Department of Botany, University of Twente, Enschede, Netherlands, E-mail: Jim_H@gmail.com

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Description

Ethyl dimethyl tetradecyl ammonium ethyl sulfate, used in dress cleaning agents, shampoos and body cleaning agents, is gathered by the Japanese synthetic substances control regulation as truly significant assessment compound substance for environmental effects. In any case, its hurtfulness data for human prosperity is lacking. This study surveyed this substance under the security assessment of existing synthetics and wellbeing projects of the service of wellbeing, work and government assistance. The MHLW drove bacterial inverse change (Ames test), *in vitro* chromosomal deviation and joined reiterated segment and conceptive/developmental destructiveness screening tests. We played out a screening evaluation of ethyl (dimethyl tetradecyl) ammonium ethyl sulfate for human prosperity. The compound showed a negative reaction in the Ames test and a positive reaction in the *in vitro* chromosomal deviation test with metabolic establishment in rodents. The united repeated segment and regenerative/developmental destructiveness screening test showed out and out reduced food use at 50 mg/kg body weight/day, but no conceptive and developmental harmfulness was taken note. The no-seen influence level of 15 mg/kg/day was gotten as a screening regard.

Screening Test

Grade 3 oral mucositis occurred in 56 patients. The cox relative peril model assessment revealed that those with lower haemoglobin levels, synchronous cisplatin and cetuximab association and a greater number of teeth showed a generally higher pace of serious oral mucositis. Determined backslide assessment uncovered that patients who had lower haemoglobin levels, sought concurrent cisplatin or cetuximab treatment and were not overseen pilocarpine showed a basically higher pace of serious oral mucositis. The presence of teeth could stimulate the oral mucosa and become a bet factor for mucositis and the association of pilocarpine could lessen the bet. Upheld fresh start atrial fibrillation in the crisis unit been represented to be connected with lamentable outcomes. Regardless, in fundamental sickness, whether temperament control therapy can achieve sinus beat modifying is dark. This study wanted to assess the impact of musicality control therapy on SR modifying for fresh start AF in fundamentally wiped out patients. This post-hoc examination of an arranged multicentre observational survey including 32 Japan serious thought units' differentiated patients and without beat control treatment for fresh start atrial fibrillation and drove a multivariable assessment using cox relative dangers backslide assessment including musicality control treatment as a period changing covariate for SR recovery. Unfamiliar substances of emerging concern like medications, individual thought things and synthetic compounds, are as frequently as conceivable tracked down in land and water proficient organic frameworks all around the planet. Information on sub deadly effects from receptiveness to normally perceived groupings of CECs is absent and the limited availability of hurtfulness data makes it hard to translate the regular importance of occasion data. In any case, the ability to survey the effects of CECs on maritime conditions is filling in importance, as distinguishing proof repeat increases.

Province of AgNPs

The brand name features of the joined AgNPs showed the round province of AgNPs with a commonplace size of 20-25 nm. The coordinated AgNPs show high cell support limit, *in vitro* antibacterial development against *Staphylococcus aureus* and *Escherichia coli* and *in vivo* antifungal properties against *Botrytis cinerea* and *Colletotrichum gloeosporioides* in tomato and strawberry freebee analyzes, independently. Our results showed that *G. applanatum* can be actually used in association of AgNPs with strong antimicrobial properties, which can be used for both clinical and agrochemical purposes. For patients with periphery white blood cell lymphoma, results using state of the art treatment with cyclophosphamide, doxorubicin, vincristine and prednisone or hack like treatment are normally poor. The ECHELON-2 survey showed that brentuximab vedotin notwithstanding cyclophosphamide, doxorubicin and prednisone showed quantifiably unmatched development free perseverance per independent central review and improvements in for the most part perseverance versus cleave for the very front treatment of patients with basic anaplastic colossal cell lymphoma or other CD30-positive PTCL. ECHELON-2 is a twofold outwardly disabled, twofold faker, randomized, counterfeit treatment controlled, dynamic comparator stage III survey. We present an exploratory update of the ECHELON-2 audit, including an assessment of 5-year PFS per expert in the assumption to-treat examination bunch. Fluid chromatography to choose the best part for blend of AgNPs.

Commentary

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Biomedical Nanotechnology has Supported to Fundamental Advancement

Lois Norn*

Department of Surgery, Tianjin Medical University, Tianjin, China

Corresponding author: Lois Norn, Department of Surgery, Tianjin Medical University, Tianjin, China, E-mail: Norn_L@gmail.com

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Description

In late numerous years, as well as existing little molecule drug therapies, biomedical development has moreover immediately progressed, provoking the improvement of various therapies considering biopharmaceuticals and healing cells. Regardless, these materials require convincing part methodologies for their assessment and creation. Nanotechnology has upheld basic progression in energy research and has immensely progressed the food creation chain. This review broadened the essential intervention of nano-based developments like present day movements of nano-based biosensors in distinctive mycotoxins, microbial pollutions, against microbial, pesticides, food added substances and tones. It furthermore included the highlighting position of nanotechnology to the extent that dynamic, shrewd food packaging and disinfection. These strategies have totally heightened the strength of food dealing with advancement and further created food quality and upkeep rules during stretch of time of convenience. Beside these moving highlights, this overview enlighten the utilization of food waste for the biogenic blend of nanoparticles and the use of nano-based materials for the reusing framework in food creation units to ensure an all-out cleaner development.

Biomedical Applications

This review essentially evaluates the current status of the controlled mix of nanomaterial using microfluidic contraptions. We portray nanomaterial isolating microfluidics, which is very huge for robotizing the association collaboration for biomedical applications. We inspect the latest microfluidics examples to achieve noteworthy metal, silica, biopolymer, quantum spots, iron oxide, carbon-based, fascinating earth-based and other nanomaterial with a specific size, blend, surface change, and morphology expected for explicit biomedical application. Screening nanomaterial has transformed into a central gadget to mix needed nanomaterial using more motorized processes with fast and repeatability, which can't be overlooked in the present microfluidic development. Likewise, we highlight biomedical purposes of nanomaterial, including imaging, zeroing in on, therapy and recognizing. Preceding clinical use, nanomaterial should be surveyed under physiological conditions, which is possible in the microfluidic system as it enlivens manufactured points, fluid streams, and the ability to control overview, we stress the clinical appraisal of nanomaterial using microfluidics which was not covered by a few different reviews. Later on, the improvement of new materials or change in existing materials including microfluidics stages and applications in various biomedical fields by utilizing all of the features of microfluidic development is typical.

Development of Nanomedicines

Cell breakdown in the lungs is a principal wellspring of illness related end all over the planet, with a very lamentable overall five-year perseverance rate. The inborn limitations related with the conventional end and supportive frameworks used for cell breakdown in the lungs have prodded the headway of nanotechnology and nanomedicines approaches, to additionally foster early examination rate and encourage all the more remarkable and safer medicinal decisions for cell breakdown in the lungs. Harmful development nanomedicines hope to individualize drug transport, finding and treatment by fitting them to each quiet's surprising physiology and over the top features on both the genomic and proteomic levels and absolutely stand adequately apart to be seen in this field. No matter what the productive utilization of nanomedicine techniques in cell breakdown in the lungs research, the clinical understanding of nanomedicines approaches stays testing on account of the confined appreciation of the affiliations that occur among nanotechnology and science, and the challenges introduced by the toxicology, pharmacology, immunology and colossal degree gathering of nanoparticles. In this review, we highlight the headway and astounding entryways related with nanomedicines use for cell breakdown in the lungs treatment and discuss the conceivable outcomes of this field. Nanotechnology and even more particularly nanotechnology-based things and materials have offered a massive potential to novel responses for enormous quantities of the on-going challenges society is defying. Regardless, nanotechnology is similarly an area of thing headway that is on occasion developing speedier than regulatory frameworks. This is a result of the incredible unpredictability of some nanomaterial, the shortfall of an all over the planet coordinated managerial definition and the different degrees of rule at an overall level. Research affiliations and regulatory bodies have spent various undertakings over the latest twenty years to adjust to these hardships.

Opinion Article

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Control of Hydration in Biomedical Materials and their Alliance Associates

Yan Li*

Department of Electric Power Stations, Kunming Medical University, Kunming, China

Corresponding author: Yan Li, Department of Electric Power Stations, Kunming Medical University, Kunming, China, E-mail: Li_Y@gmail.com

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Description

Whenever biomedical materials come into contact with body fluids, the primary reaction that occurs on the material surface is hydration; proteins are then adsorbed and denatured on the hydrated material surface. The aggregate and level of denaturation of adsorbed proteins impact coming about cell lead, including cell connection, movement, development and detachment. Biomolecules are huge for understanding the participation and normal reactions of biomedical materials to explain the occupation of hydration in biomedical materials and their affiliation assistants. Examination of the water states of hydrated materials is bewildered and remains questionable; regardless, data about interfacial water is significant for the arrangement and improvement of bleeding edge biomaterials. In this, we summarize late revelations on the hydration of designed polymers, supramolecular materials, inorganic materials, proteins and lipid layers. In addition, we present on-going advances by them way we could decipher the gathering of interfacial water and undeniable level polymer biomaterials, considering the widely appealing water thought. Fragile actuators and sensors are critical parts of systems that incorporate real development, including biomedical applications. Liquid metals can be a fruitful conductive material in the headway of such contraptions, by virtue of their extraordinary properties.

Genomic Resources

We speculated that a weather patterns front segment on the stroke starting day or during the previous days could expect a critical part in the pace of stroke. Techniques: A multi focus survey study was directed to evaluate the repeat of stroke events and their cooperation with weather patterns front passages. Progressive extreme stroke patients who were taken ownership of 7 stroke centers in 3 metropolitan networks from January to December were pursued this audit. Multivariate poisson backslide models including defer factors were used to take a gander at the regular speeds of stroke events with the day of a weather patterns front passage and the beyond 6 days, adjusting to critical effects of encompassing temperature and gaseous tension. Results: There were a total of 33 infection fronts and 13 warm fronts that dismissed the 3 metropolitan networks during the survey time period. The repeat of ischemic stroke basically extended when a warm front passed on the previous day. Ends: This study showed that a weather patterns front segment on the previous days may be connected with the occasion of stroke. The most raised percent of methylene blue defilement was seen at 92.92% inside 45 min. As a rule, revelations suggested that mediates TiO_2-NPs to be a serious dangerous material for bacterial microorganisms and mosquito hatchlings and moreover to further develop the photograph synergist variety defilement. Egyptians are at a convergence among Africa and Eurasia, giving important genomic resources for taking apart both genetic and regular factors for future altered prescription. Two individual Egyptian whole genomes have been disseminated as of now by us and here nine female whole genome progressions with clinical information have been added to become the genomic resource of Egyptian individual genomes.

Data of CCAS

The target of this work was to get sicknesses in patients by understanding the fine-grained diseases and contamination development showed up by progresses in illnesses. We comprehend this by introducing our earlier work on a state of the art data show, which portrays a disease as a causal chain of bizarre states .Here, we propose a design, EHR2CCAS, for fostering a structure to design electronic prosperity record data to CCAS. EHR2CCAS is a framework containing modules that entrance heterogeneous EHR to evaluate the presence of uncommon states in a CCAS for a patient in a given time window. EHR2CCAS applies ace driven and data driven strategies to perceive uncommon states from coordinated and unstructured EHR data. It features data driven approaches for opening clinical texts and attributions considering the EHR common properties and the causal CCAS structure. This study presents the CCAS of steady kidney ailment for example. An arranging structure between the EHR from the college of Tokyo clinic and CCAS of on-going kidney disease was fabricated and considered as opposed to dominate remark. The structure achieved elevated requirement execution in distinctive uncommon states that had strong game plan among annotators. Our treatment of story arrangements in texts and our attribution of the presence of a surprising state extraordinarily additionally fostered the assumption execution. EHR2CCAS presents patient data depicting the common presence of bizarre states in CCAS, which is useful in individual ailment development, the leaders. Further assessment of the partition of progress among

uncommon states yielded by EHR2CCAS can add to recognizing contamination subtypes. The effect of a weather patterns front segment is rarely evaluated on stroke events.

Opinion Article

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Managing and Treatment of Biomedical Waste

Yon Chin*

Department of Biomedical Sciences, University of Tehran, Tehran, Iran

Corresponding author: Yon Chin, Department of Biomedical Sciences, University of Tehran, Tehran, Iran, E-mail: Chin_Y@gmail.com

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Description

There might be threats to medical care laborers, patients, networks and the climate in the event that biomedical waste isn't as expected made due. The reason for this study was to assess the way in which biomedical waste is endlessly taken care of in different Egyptian medical services offices. Utilizing a waste management specific changed review poll, respondents were overviewed in ten essential medical care settings and five clinics. The World Health Organization (WHO) gave this poll to assess the biomedical garbage removal handling frameworks. Because of the shortfall of composed strategies and methodology, scientists found that clinics and essential medical care settings treat biomedical waste insufficiently. Subsequently, biomedical waste perils might adversely affect medical services laborers, patients, the local area and the climate. As well as laying out squander the executives preparing programs for all medical care laborers, the making of waste administration arrangements, plans and conventions is unequivocally supported. It might likewise incorporate waste related with the age of biomedical waste that outwardly seems, by all accounts, to be of clinical or research facility beginning (for example bundling, unused wraps, implantation packs and so on.), too research lab squander containing biomolecules or life forms that are mostly confined from ecological delivery. As nitty gritty beneath, disposed of sharps are viewed as biomedical waste regardless of whether they are polluted, because of the chance of being defiled with blood and their affinity to cause injury when not appropriately contained and arranged. Biomedical waste is a kind of bio-waste.

Biomedical Waste

The regulations overseeing garbage removal in Egypt are dra ted by the service of natural issues and the service of wellbeing and populace related to each other. The waste created in medical services settings is viewed as perilous under the guidelines and certain safety measures should be taken during assortment, dealing with and removal. This study means to assess the dealing with and therapy of biomedical waste in different medical services settings since there is presently no data that depicts the genuine act of taking care of these sorts of side-effects. The sorts of care and administrations gave, as well as the kinds of biomedical waste delivered, shi ted starting with one medical services office then onto the next and from one division to another inside a similar office. Taking everything into account, this investigation discovered that biomedical waste was ineffectively isolated, gathered and shipped. Notwithstanding poor defensive measures, there were no composed arrangements or clear rules and it were incapable to prepare programs. Biomedical perils represent a more prominent danger to staff, patients and the local area overall in view of every one of these variables.

Pathogenic Microorganisms

In medical care settings, contamination control and cleanliness programs incorporate waste administration as a fundamental part. Since they create a ton of biomedical waste, these settings assume a major part in local area gained diseases. The gamble of injury or potentially contamination during dealing with and removal recognizes biomedical waste. Sharps (needles or surgical tool cutting edges), neurotic squanders (physical body parts, microbial science societies and blood tests) and irresistible squanders (things polluted with body liquids and releases like dressings, catheters and I.V. lines) are among the squanders that are focused on for precautionary measures during dealing with and removal. Different wastes made in clinical consideration settings consolidate radioactive wastes, mercury containing instruments and Polyvinyl Chloride (PVC) plastics. These are among the most destructive medical services side-effects to the climate. It's critical to consider medical services squander as a supply for pathogenic microorganisms that can prompt pollution and disease. These microorganisms can represent a serious danger to human wellbeing and the climate on the off chance that waste isn't as expected made due. They can be spread through direct contact, through the air, or through different vectors. Issues like blood-borne microbes are bound to influence the gatherings most in danger when biomedical waste is dealt with inappropriately: Medical care laborers, scroungers and metropolitan specialists. In numerous nations and urban communities, like Iran, Croatia and Karachi, unsafe and non-dangerous biomedical squanders are not as expected isolated, and there are no suitable waste therapy offices or techniques. Also, they have insufficient worker preparing and no private defensive gear, as well as waste handling and treatment regulations that are either not controlled or don't exist.

Perspective

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Planning Strategies for Biomedical Miniature and Nano Hydrogels

Agostoni Luo*

Department of Engineering and Materials Science, University of Washington, Seattle, USA

Corresponding author: Agostoni Luo, Department of Engineering and Materials Science, University of Washington, Seattle, USA, E-mail: Luo_A@gmail.com

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Description

A novel practical material known as miniature nano hydrogel has gotten a ton of consideration across different fields. The micronano hydrogels are viewed as promising specialists in tissue fix designing because of their capacity to accomplish negligibly obtrusive fix, high water content and high unambiguous surface region. The latest headways in the utilization of microgels for nearby medication conveyance, bone tissue fix, delicate tissue fix and immunomodulation, as well as the latest progressions in the utilization of nanohydrogels for ligament fix, antibacterial, antitumor/malignant growth nerve fix and sickness avoidance and analysis, are depicted exhaustively. Furthermore, the main future exploration headings for miniature nano hydrogel planning innovations are clarified. Hydrogel is a significantly hydrophilic sensitive material, due to its inside 3D cross-associated network structure like extracellular system and all the while has the characteristics of high growing, incredible biocompatibility and outstanding shape flexibility. Various applications for hydrogel incorporate injury dressings, platforms for tissue designing, tissue fixes and medication conveyance frameworks. In any case, in view of the gamble of disease presented by implantation injury, ordinary mass hydrogels are progressively restricted in clinical use, especially when explicit sizes are required. Since injectable hydrogels have superb self-recuperating properties and could actually gel *in situ*, point-based implantation of sporadic threedimensional designs can be achieved with negligible obtrusiveness.

Nano Hydrogels

Microgels can either self-gather in situ to shape unpredictable designs or typify various dynamic elements for tissue recovery. Their normal distance across is somewhere in the range. Splash drying, electro hydrodynamic showering, microfluidics and 3D-bioprinting are only a couple of the normal ways to deal with making miniature hydrogels that are examined in this segment. A shower dryer, which regularly comprises of an atomizer and a drying chamber, is utilized in the splash drying strategy. Medications, polymers and molecule arrangements and suspensions are atomized into fine drops. In the drying chamber, a flood of hot air makes the dissolvable rapidly vanish from the drops, bringing about the development of microspheres or microgels with a width of one to ten micrometers. A high level technique for fluid atomization called electro hydrodynamic showering utilizes a high electric field to beat the fluid's surface pressure. Basically, the polymer arrangement is expelled through a high-voltage metal needle tip or spout. Affected by areas of strength for a field, the drops in the needle that is associated with the high-voltage generator become Taylor cones and afterward cross-connection to shape micron-sized containers. In light of emulsion strategies, drop microfluidics is an ideal stage for the amalgamation of hydrogel microspheres. Mathematical channels, for example, T-molded and Y-shaped associations, interface at least two immiscible liquids in the microfluidic emulsion framework and a while later globules are molded. Miniature nano hydrogels defeat the disadvantages of traditional hydrogels to make it conceivable to convey drugs or biomolecules to a more extensive region and further away. An entirely different universe of opportunities for tissue fix designing have arisen because of huge headways in the specialized strategies and designing plan of miniature nano hydrogel readiness throughout the course of recent many years.

Fundamentally Polymerizing

Regardless, there are as yet a couple of irrefutable weights here, in particular, in view of the unbalanced shape and enormous size of the hydrogel, a to some degree high and disproportionate mixture force is certainly made during implantation. Likewise, mass injectable gels' hard to-oversee discharge pace of typified tranquilizes habitually brings about quick medication movement disappointment. In view of speedier gelation, the collaboration could provoke pack disillusionment and spillage going before conveyance we investigate the very biomedical purposes of microgels, including skin drug movement, bone tissue fix, sensitive tissue fix and immunomodulation, as well as nanogels for tissue fix, including tendon fix, antagonistic to tainting, against development/sickness, nerve fix and expectation and assurance of diseases. More or less, the motivation behind this audit is to introduce the likely utilizations of miniature nano hydrogels in biomedicine and to introduce new open doors for the plan and improvement of cutting edge biomaterials later on. With that in mind, the standards and methods of miniature nano hydrogel readiness are summed up. A rich library of polymers have been used for the arrangement and making of biomedical hydrogels. Regular and manufactured polymers are the two fundamental sorts of

these polymers. The substance strategy incorporates covalent crosslinking and dynamic covalent crosslinking, as well as free extreme polymerization, Schiff base response, and other comparable cycles. The actual strategy, then again, is fundamentally partitioned into synthetic and actual techniques relying upon the arrangement strategy and system. Peptide self-gathering, have visitor left-and-right, polymer chain ensnarement, hydrogen holding and other actual strategies are models. Cellulose is a straight polysaccharide comprised of rehashing D-glucose units that are connected by a linkage of under 1, 4. Cellulose is the chief piece of plant cell wall and is seen as the most abundant regular polymer on earth. Hydrolyzed collagen yields gelatin, a stringy protein with a particular amino corrosive succession. Most of connective tissue, including skin, ligaments, and bones, is collagen. Polyvinyl Alcohol (PVA) is a straight manufactured polymer made by hydrolyzing ethyl polyacetate either somewhat or totally. One of a handful of the vinyl polymers that are dissolvable in water however practically insoluble in natural solvents is PVA, which is notable. Polyethylene Glycol (PEG) is a manufactured, water-solvent, gooey, amphiphilic polymer that is commonly made by polymerizing ethylene oxide in an anionic or cationic way.

Commentary

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Plasmas with Low Fragmentary Ionization of Bioactive Compounds

Xin Xu*

Department of Biomedical Engineering, Soochow University, Suzhou, China

Corresponding author: Xin Xu, Department of Biomedical Engineering, Soochow University, Suzhou, China, E-mail: Xu_X@gmail.com

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Description

As a significant peculiarity to screen infection improvement, cell flagging for the most part happens at the connection point between organic entities/cells or between creatures/cells and abiotic materials. In this way, tracking down a technique to fabricate the particular biomedical connection points will assist with directing data transmission and produce better restorative outcomes to help patients. In the previous many years, plasmas containing lively and dynamic species have been utilized to develop different connection points to fulfill biomedical needs like microorganisms' inactivation, tissue recovery, disease treatment, *etc*. In light of the powerful elements of plasma changed surfaces, this smaller than usual audit is meant to sum up the condition of-craftsmanship plasma-enacted interfaces and give direction to scientists to choose the appropriate plasma and handling conditions to plan and get ready connection points with the ideal organic and related capabilities.

Bioactive Compounds

Bioactive mixtures have not been sufficiently characterized for the degree of their bioactivity in people, showing that their job in sickness counteraction and support stays obscure. Numerous productive bio-interfaces have been intended to address different biomedical requests, for instance, further developing therapeutics to alleviate patients from uneasiness and plasma innovation has arisen to be extremely helpful in biomedical designing and biomaterials research. Plasma's active species are friendly to normal cells but kill pathogenic microorganisms directly when they interact with them. Also, appropriate plasma treatment can encourage tissue recovery and hinder growth movement. Plasmas with low fragmentary ionization are of extraordinary interest for materials handling since electrons are so light, contrasted with iotas and atoms, that energy trade between the electrons and impartial gas is extremely wasteful. Consequently, the electrons can be kept up with an exceptionally high comparable temperatures a huge number of kelvins, identical to a few electronvolts normal energy while the nonpartisan particles stay at the encompassing temperature. These vivacious electrons can prompt many cycles that would somehow be truly impossible at low temperatures, like separation of antecedent particles and the making of huge amounts of free revolutionaries. Cells and organic entities have a convoluted framework to do explicit missions that follow a succession of steps spanned by signal transduction. Signal correspondence which generally happens at the connection points between the outside substances and inside natural climate directs the organic way of behaving particularly that related with infection improvement.

Plasma Fragmentary Ionization

In comparison to many other engineering fields, biomedical engineering has only recently emerged as a distinct field of study. Such a development is normal as another field change from being an interdisciplinary specialization among as of now settled fields to being viewed as a field in itself. A large part of the work in biomedical designing comprises of innovative work, crossing an expansive cluster of subfields (see underneath). The creation of biocompatible prostheses, various diagnostic and therapeutic medical devices, including clinical equipment and micro-implants and other applications of biomedical engineering are prominent. As a matter of fact, most physiological cycles connected with digestion, apoptosis and other self-fixing exercises depend on signal transduction at the points of interaction and the legitimate connection points are critical to organic capabilities and biomaterials research. Other than being the primary state in extraterrestrial matters, plasmas exist through lightning and aurora on earth. Plasmas can be named nonthermal and warm ones relying upon the temperature and furthermore as metal and non-metal plasmas as per the fixings. As the metastable dynamic species in plasmas are very lively, processes consolidating man-caused plasmas to have high proficiency and efficiency and are generally utilized financially, particularly in the microelectronics and coatings industry. Precursor dissociation is limited and deposition rates are low in capacitive plasmas, which are typically very lightly ionized. A lot denser plasmas can be made utilizing inductive releases, in which an inductive loop energized with a high-recurrence signal prompts an electric field inside the release, speeding up electrons in the actual plasma as opposed to right at the sheath edge. Electron cyclotron reverberation reactors and helicon wave radio wires have likewise been utilized to make high-thickness releases.

Commentary

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Brief on Alzheimer's Infection: From Finding to Treating

Xin Chen*

Department of Bioinformatics, University of São Paulo, Ribeirão Preto, Brazil

Corresponding author: Xin Chen, Department of Bioinformatics, University of São Paulo, Ribeirão Preto, Brazil, E-mail: Chen_X@gmail.com

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Description

Alzheimer's illness, perhaps of the most well-known constant neurodegenerative sickness, is described by memory hindrance, synaptic brokenness and character changes. The obsessive elements of promotion are Aβ collection, tau protein improvement, oxidative pressure and safe irritation. It is still challenging to detect AD early and treat it promptly due to its complicated and ambiguous pathogenesis. Because of the one of a kind physical, electrical, attractive and optical properties of Nanoparticles (NPs), nanotechnology has shown extraordinary potential for identifying and treating promotion. This audit gives an outline of the most recent improvements in promotion recognition by means of nanotechnology in light of NPs with electrochemical detecting, optical detecting and imaging procedures. In the meantime, we draw attention to significant advancements in targeting disease biomarkers, stem-cell therapy and immunotherapy-based nanotechnology-based AD treatment. In addition, we discuss a promising possibility for nanotechnology-based AD diagnosis and treatment and summarize the current obstacles.

Alzheimer's Infection

Nanoparticles (NPs) stand out enough to be noticed concerning therapeutics and determination, due to their special physicochemical properties that upset clinical treatment with more powerful, less poisonous and shrewd results. This section gives an outline of significant classes of NPs utilized for drug conveyance and determination, featuring their manufacture strategies, portrayal techniques and physicochemical properties. The utilities of NPs in drug/quality conveyance are then summed up, which principally center on the capacities of NPs to stack drug/quality cargoes, beat fundamental conveyance hindrances and intercede canny medication/quality conveyance in ailing tissues/cells. Additionally, the clinical benefits of nanomedicine are outlined and discussed. The course of Alzheimer's is by and large portrayed in three phases, with a dynamic example of mental and utilitarian impairment. The three phases are depicted as right on time or gentle, center or moderate and late or severe. The illness is known to focus on the hippocampus which is related with memory and this is liable for the main side effects of memory impedance. As the illness advances so does the level of memory weakness. Unobtrusive issues with the chief elements of mindfulness, arranging, adaptability and unique reasoning, or disabilities in semantic memory (memory of implications and idea connections) can likewise be suggestive of the beginning phases of Alzheimer's disease. Unresponsiveness and despondency should be visible at this stage, with disregard staying as the most determined side effect over the span of the disease.

Investigation of Patients

Mild Cognitive Impairment (MCI) is in many cases viewed as a temporary stage between typical maturing and dementia. When memory loss is the predominant symptom, MCI is referred to as amnestic MCI and it is frequently seen as a prodromal stage of Alzheimer's disease. Amnestic MCI has a greater than 90% likelihood of being associated with Alzheimer's disease. MCI can present with a variety of symptoms. Neurodegenerative infections incorporate Parkinson's Disease (PD), Alzheimer's sickness, Multiple Sclerosis (MS) and Amyotrophic Lateral Sclerosis (ALS). The safety of all vaccines, including COVID-19, is impacted by age and immunosuppression, both of which are frequently associated with neurodegenerative diseases. The safety of COVID-19 vaccines for patients with neurodegenerative diseases requires additional investigation; notwithstanding, introductory information support immunization because of a satisfactory security profile. For MS patients, studies of patients with different sclerosis that were immunized shown a positive security profile. Creators encourage more investigations on inoculating patients with neurodegenerative infections. The requirement for an interdisciplinary group becomes apparent as issues in various spaces of best practice care are tended to: End-of-life and death management, the grieving process for the patient and surviving family, social issues, spiritual questions, disease management and physical and psychological symptoms. Amazing correspondence among colleagues is foremost as the course of care conveyance advances, including evaluations, the sharing of data, navigation and the preparation and conveyance of care.

Commentary

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Proficiency of Point of Interaction Strain for Biomedical Applications

Stain Julia*

Department of Biomedical Engineering, University of Newcastle, Newcastle, UK

Corresponding author: Stain Julia, Department of Biomedical Engineering, University of Newcastle, Newcastle, UK, E-mail: Julia_S@gmail.com

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Description

Sleeve cathode is a fundamental part of a brain prosthesis framework. It is frequently utilized to apply electrical boosts on engine nerve filaments that innervate muscles or on the other hand to record brain signals from the fringe nerves. It is accounted for that a tension more than 20 mmHg is destructive for the nerve trunk. In this manner, estimating the connection point strain between the sleeve and a nerve trunk gives a way to screen the strength of the nerve tissue. The objective of this study is to foster a miniature capacitive tension sensor which can be inserted into the sleeve cathode for in situ checking of the connection point strain between embedded sleeve and nerve tissue. The alignment results uncovered two significant plan factors, to be specific, the mathematical properties of dielectric layer and the thickness of protecting layer for fostering the strain sensor.

Epileptic Disorders

Neuroprosthetics has delighted in expanding interest among scientists, medical care experts, the media and the overall population throughout the course of recent many years. Scientists, engineers and medical professionals are working more closely together to create new neuroprostheses. It is a quickly developing field with enormous potential for rebuilding or supplementation of a current physical process or sense, as well as making of possibly novel practical and abilities to detect. With quick mechanical headways, huge moral worries connected with neuroprostheses have been noted. Here we examine such moral issues related with neuroprostheses at their different progressive phases and use. The field of neuroprosthetics offers gigantic commitment for the critical subset of patients who can't be controlled with meds and are not qualified for a medical procedure. However VNS and RNS are the main FDA-supported modalities as of now, DBS shows up liable to get endorsement sometime in the future. As advances become more modest and battery duration builds, enhancements will be found in the gadgets accessible for the treatment of epilepsy. Optogenetics offers expect the advancement of strong new methods in beforehand untreatable seizure problems. Since these modalities and others examined frequently give help to epileptic disorders of various etiologies, cautious patient determination stays the main consider treatment.

Biomedical Applications

As long as the nerve trunk heals naturally over time, this electrode can measure signals with a higher signal-to-noise ratio. The list to pass judgment on the ailment of the nerve was the point of interaction tension between the level cathode and the compacted nerve trunk. A sensor is required to measure the pressure at the interface between the nerve and either the spiral or elliptic electrode. In addition, this sort of strain sensors might be pertinent to identify the tension on different tissues of people, like veins, bladder and skin. There are essentially two sorts of miniature strain sensors, specifically, the Piezoresistive (PR) and capacitive tension sensors. Piezoresistive tension sensors can be effortlessly created since the detecting component, pizeoresistance, can be delivered by doping boron particle on silicon. The PR pressure sensor has high linearity yet it is extremely delicate to temperature change and temperature remuneration circuits must be utilized. Capacitive pressure sensors, on the other hand, are more sensitive and less sensitive to changes in temperature in the environment. For most biomedical applications, two significant plan factors must be thought of. One is the more modest strain scopes of 500 mmHg and the other is that the tension sensors ought not to be impacted by heat dissemination came about because of circuits or tissue while being embedded. So the capacitive strain sensors better fit the plan particulars of the biomedical applications. Clinical pressure swathes are generally applied as different or covering layers, which brings about the increment of the general thickness of gauze texture over the appendage. Two layers of bandage are applied in a spiral with 45% overlap, while three layers are applied in a spiral with 30% overlap.

Opinion Article

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Applications of Nano Technological in Biomedical Designing

Lewis Belin*

Department of Biomedical Engineering, Yeungnam University, Gyeongbuk, Republic of Korea

Corresponding author: Lewis Belin, Department of Biomedical Engineering, Yeungnam University, Gyeongbuk, Republic of Korea, E-mail: Belin_L@gmail.com

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Description

It is anticipated that advancements in nanomedicine will fundamentally alter the method of disease diagnosis and treatment. The eventual fate of biomedical designing and clinical therapies could be essentially affected by nanotechnology in various ways. Before using nanotechnology in the workplace, toxicology testing procedures need to be correlated and reproducible and biomedical applications *in vivo* and *in vitro* results need to be sufficiently understood. As of late, key examinations in the areas of security and resilience, both non-clinical and clinical, have become vital to make imminent business applications. In spite of the fact that it hasn't yet been completely understood, the potential for nanopatterning of usable clinical gadgets is huge. Drug designing, tissue designing, hereditary designing, clinical gadgets advancement, imaging and antiviral utilization were among the applications proposed. More review is required on the immunological and provocative reactions, the impacts of responses at the point of interaction of tissue/blood and strands, prescription focus and the results.

Epileptic Disorders

Nanoparticles (NPs) certainly stand out concerning therapeutics and conclusion, due to their interesting physicochemical properties that reform clinical treatment with more powerful, less harmful and brilliant results. This part gives an outline of significant classifications of NPs utilized for drug conveyance and determination, featuring their manufacture procedures, portrayal techniques and physicochemical properties. The capabilities of NPs to load drug/gene cargoes, overcome systemic delivery barriers and mediate intelligent drug/gene delivery in diseased tissues/cells are the primary focus of the summary of the utilities of NPs in drug/gene delivery. The clinical accomplishments of nanomedicine are likewise illustrated and examined. At long last, the uses of NPs for *in vitro* determination, *in vivo* imaging and theranostics are presented. Nanotechnology items have become progressively significant in biomedicine, bringing about the rise of nanobiotechnology. Assessed the purposes of nanomaterials in nanobiotechnology, including determination, prescription conveyance frameworks and prosthetics. Underscored that nanotechnology is the creation and development of exceptionally coordinated nanostructured materials that answer explicit upgrades. It is practical to join biospecific atoms with nanoparticles using compound or actual strategies by exploiting explicit natural communications. The purposes of nanoscale materials are tuned by surface science and physical science. Tissue and embed designing which are utilized in biomedical designing have profited from nanotechnology. An increase in activity can be caused by a total mass change of approximately 90% caused by the atom concentration on the nanosurface.

Biomedical Applications

To improve bond strength, nonporous Titania covered in hydroxyapatite was annealed in an argon atmosphere. An interfacial response between sodium borate glass covering and pre-warmed titanium substrates at expanded temperature was utilized to fabricate nanoscale bar exhibits on titanium surfaces. Self-collected monolayers can modify a surface's geology and science, coming about in new physical as well as natural highlights. Examples include nanoparticle deposition, ion beam deposition and other physical processes. Corrosive scratching and anodisation are two of the substance processes inspected. Correspondingly to nanotube creation, a couple of extraordinary strategies have been recorded. Imprint lithography is gaining popularity as a nanopatterning alternative to conventional photolithography because it makes it simple to create high-resolution 2D and 3D structures. Egg whites can restrict cell-embed communication by firmly sticking to hydrophobic surfaces, forestalling substitution by other extracellular network proteins. Adsorbed egg whites, then again, can be supplanted by extracellular framework proteins when it connects to hydrophilic gatherings. It is necessary to modify the surface of the implant to strengthen the bone implant interaction and guarantee successful osteointegration. Exposure dose and duration determine nanomaterial toxicity. The redesign efforts that are based on comprehending the mechanism of toxicity will be led by the primary modes of toxicity. In spite of nanoparticles charming natural applications, little is had some significant awareness of their harmfulness.

Opinion Article

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Bio-Research of Gas Chromatography in Scientific Strategy Advancement

John Salem*

Department of Bio-Research, University of Amsterdam, Amsterdam, Netherlands

Corresponding author: John Salem, Department of Bio-Research, University of Amsterdam, Amsterdam, Netherlands, E-mail: Salem_J@gmail.com

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Description

Gas chromatography is a generally utilized logical method tracked down in numerous research centers all over the planet. In any case, not all analytes of interest can be straightforwardly broke down by gas chromatography, e.g., low unpredictability, awry pinnacles, or thermolabile nature. In such circumstances, logical derivatization, in spite of being a tedious and lumbering additional move toward test planning, is expected to make analytes more reasonable for gas chromatographic examination by working on their unpredictability, warm security and perceptibility. Injector port derivatization happens in a warmed gas chromatography infusion port; the method has expansive applications in food, biomedical and natural examination. It is simple to use in analytical development processes, derivatizes well and requires fewer dangerous chemical reagents in smaller quantities. This survey plans to cover ongoing utilizations of injector port derivatization strategies distributed inside the most recent decade to work with injector port derivatization in logical strategy improvement applications.

Utilization of Detectors

The decision of transporter gas (portable stage) is significant. Hydrogen has a scope of stream rates that are tantamount to helium in effectiveness. Notwithstanding, helium might be more proficient and give the best division in the event that stream rates are advanced. Helium is non-combustible and works with a more noteworthy number of locators and more seasoned instruments. Thusly, helium is the most well-known transporter gas utilized. Nonetheless, the cost of helium has gone up significantly over ongoing years, making a rising number of chromatographers change to hydrogen gas. Authentic use, instead of reasonable thought, may add to the proceeded with particular utilization of helium. Usually utilized locators are the Fire Ionization Detector (FID) and the Thermal Conductivity Detector (TCD). FIDs are primarily sensitive to hydrocarbons and are more sensitive to them than TCD. FIDs cannot detect water or carbon dioxide, making them ideal for environmental organic analyte analysis. FID is two to three times more sensitive to analyte detection than TCD. Gas Chromatography (GC) is a standard partition method that offers brilliant division and recognition capacities. Notwithstanding, examination by GC has a few downsides. Polar natural particles with utilitarian gatherings comprising of hydroxyl, carboxylic corrosive, amine and thiol bring about deviated tops in GC division because of their propensity to communicate with open silanol bunches in the fixed stage.

Gas Chromatography

Fluid chromatography is frequently suggested for such examination. In GC, analytes are presented to raise temperatures, which thusly limit the accessibility of thermostable analytes that can stand raised temperatures. The Injector-Port Derivatization (IPD) approach is a web-based method where analytes are derivatized in a warmed GC injector port. IPD, which works with the presentation of the example and derivatization reagent to the infusion port, empowers the disentanglement of the example readiness process, diminishes natural dissolvable utilization, evades risky circumstances during test planning and decreases the arrangement of harmful synthetic waste. On the other hand, the subsequent methodology, particle pair in-port derivatization, is to utilize quaternary amine particle matching specialists for the double motivation behind analyte extraction from the example lattice and afterward hence derivatize analytes by means of alkylation-type responses on a warmed GC injector port for examination. The transporter gas direct speed influences the examination similarly that temperature does the higher the direct speed the quicker the investigation, however the lower the partition between analytes. Choosing the direct speed is consequently a similar split the difference between the degree of partition and length of investigation as choosing the segment temperature. The direct speed will be executed through the transporter gas stream rate, with respect to the inward distance across of the section. The decision of delta type and infusion method relies upon in the event that the example is in fluid, gas, adsorbed, or strong structure, and on whether a dissolvable grid is available that must be disintegrated. Using a COC injector, dissolved samples can be injected directly into the column.

Opinion Article

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Biomedical Waste Recycling during a Pandemic

Navon Lee*

Department of Biomedical Hazard, University of Alabama, Birmingham, USA

Corresponding author: Navon Lee, Department of Biomedical Hazard, University of Alabama, Birmingham, USA, E-mail: Lee_N@gmail.com

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Description

Clinical waste has expanded in the beyond 3 years because of the COVID sickness (Coronavirus) pandemic. This condition is supposed to compound because of the developing medical services markets and maturing populace, presenting wellbeing dangers to the public by means of ecological impressions. To lighten these effects, there is an earnest requirement for clinical waste administration. This article emphasizes the processes, materials and chemistry involved in each practice, as well as the benefits of medical waste reuse and recycling. It also focuses on the drawbacks of the current methods of disposal. Further conversation is given on the substance and mechanical reusing of plastics as the ruling material in biomedical applications and potential techniques and difficulties in reusing and reusing biomedical materials are investigated in this survey.

Biomedical Waste

Removal of this waste is a natural worry, as numerous clinical squanders are delegated irresistible or biohazardous and might actually prompt the spread of irresistible sickness. The most widely recognized risk for people is the contamination which likewise influences other living creatures in the locale. People's bodies accumulate harmful substances or microbes as a result of daily exposure to landfill waste. Removal happens off-site, at an area that is not quite the same as the site of age. Treatment might happen nearby or off-site. On location therapy of enormous amounts of biomedical waste for the most part requires the utilization of moderately costly hardware and is for the most part just financially savvy for exceptionally huge medical clinics and significant colleges who have the space, work and spending plan to work such gear. Off-site therapy and removal includes recruiting of a biomedical garbage removal administration (likewise called a truck administration) whose workers are prepared to gather and take away biomedical waste in extraordinary compartments (generally cardboard boxes, or reusable plastic canisters) for therapy at an office intended to deal with biomedical waste. Medical services squander is characterized as the waste produced by means of operations at medical care or exploration offices and research facilities. Clinical waste is partitioned into two classifications: Risky waste, including natural, compound, radioactive, as well as actual impressions, non-dangerous waste, comprising around 80% of waste created from medical services exercises that are like homegrown waste. Inappropriate clinical waste dealing with and removal might force wellbeing gambles on medical care laborers and the public.

Medical Services of Pandemic

This essentially happens through the transmission of irresistible or drug-safe microorganisms, poisonous openness to substance and drug squander and the arrival of air contaminations. Taking off clinical waste creation because of the Coronavirus pandemic is supposed to be sustained by the extended development of arising medical services areas and the maturing populace, presenting ecological dangers and causing sicknesses in countless individuals. The majority of strategies for reducing waste are based on the waste hierarchy. The point of the waste pecking order is to extricate the greatest commonsense advantages from items and to create the base measure of end squander; see: Asset recovery. The waste pecking order is addressed as a pyramid on the grounds that the fundamental reason is that strategies ought to elevate measures to forestall the age of waste. Following this step is material recuperation and waste-to-energy. The final step is disposal, either through incineration without energy recovery or in landfills. This last step is the last retreat for squander that has not been forestalled, redirected, or recovered. The waste order addresses the movement of an item or material through the successive phases of the pyramid of waste administration. The pecking order addresses the last option parts of the life-cycle for every item. By and large, plastic waste is reused utilizing essential, optional, tertiary, or quaternary pathways. Essential reusing (otherwise called re-expulsion and shut circle reusing) is restricted to practically perfect waste and is by and large took advantage of in the handling line, on the grounds that the reused items should have a comparable quality to the first plastic.

Perspective

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Environmental Audit Rules for Clinical Benefits Region

Rant Jen*

Department of Biomedical Science, Kyoto University, Kyoto, Japan

Corresponding author: Rant Jen, Department of Biomedical Science, Kyoto University, Kyoto, Japan, E-mail: Jen_R@gmail.com

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Description

In the medical field, Biomedical Waste (BMW) is a growing health and environmental issue. BMW in any design made from clinical facilities during examination, operation, the leading group of patients, hostile to disease specialists, radioactive isotope needs genuine dealing with and evacuation. In the field of dentistry, mercury waste, waste from dental blend, lead and silver-containing waste were by and large found and have serious risks for prosperity and are moreover biological dangers. This moreover makes a difference and peril of airborne microorganisms if it's improperly managed and disposed of. All of these spoiled waste-like needles, needles, sharps, blood-soaked fabric, which prompts illnesses, ought to be properly disposed of in various assortment codes displayed for a particular order of biomedical waste as per the principles from the public expert for the evacuation. This article enlightens the classes of biomedical waste and wide composing review on the investigation performed, waste made from dental centers and facilities.

Clinical Benefits

Clinical thought is irreplaceable for our life and prosperity, yet the unseemly organization of biomedical waste causes a prompt prosperity impact and damages the natural framework including generally changed vegetation. Biomedical waste organization is a key piece of ordinary and contemporary plan of clinical benefits. Squander the executives contains all of the procedures and activities necessary to oversee waste from its inception to its final disposal. Waste conveyed over clinical benefits practices conveys a higher potential for defilement and injury than another kind of waste. It is basic that all clinical waste materials are disengaged at the spot old enough, appropriately treated and disposed of safely. In Ayurvedic clinics, a significant portion of the medical staff was completely unaware of the proper disposal of biomedical waste. Biomedical waste management necessitates prompt scholarly consideration by cultivating mindfulness in classrooms due to its impact on health and the environment. Additionally, we should concentrate on eco-friendly and innovative methods for its removal. Tremendous measures of this oil are open and various underhanded parts misuse this spent oil. On the quest to either utilize or eliminate this waste oil, an eco-friendly method ought to be discovered.

Environmental Analysis

Clinical gas systems are prosperity essential structures in light of their relationship with fundamental thought conditions. In particular, the oxygen gas supply system has a lot of problems with people and equipment communicating while operating the system and managing crises. As a result, it contains numerous threats that necessitate stringent security measures in order to maintain the integrity of the framework. Due to the fact that their direct thinking suspicion is unable to adequately portray the genuine way of behaving of current socio-specialized frameworks, which are described by close couplings and complex collaborations among specialized, human and authoritative perspectives, traditional threat investigation strategies suffer from shortcomings. Then again is another danger examination approach that records for the causal associations between system parts and their perilous affiliations, allowing the blend of both word related and process prosperity. STPA is comprehensively used in the vehicle, flight, and flying organizations while there are two or three purposes of STPA in clinical benefits space. In order to examine the risks associated with oxygen supply structures and the clinical gas pipeline in a low- to medium-paying nation, this paper suggests employing the STPA strategy. Specifically, the assessment considers the emergencies that come from the total or partial disillusionment of oxygen supply and the dangers associated with fleeting reconstructing of the clinical oxygen structure. The results show that STPA adds to perceiving the hazards coming about in view of the obstacle between the human, machines, equipment and focusing on the hazardous effect of the structure parts on each other. This study offers control measures to prevent the risky collaboration of the framework components and to increase the reaction time to oxygen failures, both of which significantly reduce the expected results.

Perspective

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Clinical Methodology of Polycystic Ovary Disorder and Uterine Corpus Endometrial Carcinoma

Lin Jin*

Department of Bioinformatics, University of Chinese Academy of Sciences, Beijing, China

Corresponding author: Lin Jin, Department of Bioinformatics, University of Chinese Academy of Sciences, Beijing, China, E-mail: Jin_L@gmail.com

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Description

People with Polycystic Ovary Syndrome (PCOS) have a higher risk of developing Uterine Corpus Endometrial Carcinoma (UCEC) than the general population. Regardless, the etiological components basic this affiliation stay muddled. Through a combination of bioinformatics and *in vitro* research, this study sought to define a common gene signature, clarify the pathophysiological mechanisms and identify potential therapeutic agents. We distinguished Differentially Expressed Genes (DEGs) normal to PCOS and UCEC, essentially engaged with chemical flagging and safe reactions. Invulnerable microenvironment investigation uncovered positive relationship of MMP9 and TLR2 with different insusceptible cell types and designated spots and a range of chemokines and their receptors. MAZ arose as the essential record factor overseeing the statement of these center point qualities in both PCOS and UCEC. Thusly, our examination clarifies the normal pathogenic pathways and hereditary markers shared by PCOS and UCEC, giving an establishment to future helpful procedures and medication disclosure.

Endometrial Carcinomas

The processing of images and signals makes it possible to get useful results from a lot of raw data. In the field of hereditary qualities, it supports sequencing and commenting on genomes and their noticed changes. Bioinformatics incorporates text mining of natural writing and the advancement of organic and quality ontologies to sort out and question organic information. It likewise assumes a part in the examination of quality and protein articulation and guideline. Tools developed in bioinformatics aid in the comparison, analysis and interpretation of genomic and genetic data, as well as, more generally, in comprehending evolutionary aspects of molecular biology. At a more integrative level, it breaks down and index the natural pathways and organizations that are a significant piece of frameworks science. Women with PCOS will quite often have focal corpulence, yet review are clashing concerning whether instinctive and subcutaneous stomach fat is expanded, unaltered, or diminished in womens with PCOS comparative with non-PCOS ladies with a similar weight index. Regardless, androgens, like testosterone, androstanolone (dihydrotestosterone) and nandrolone decanoate have been found to increment instinctive fat statement in both female creatures and womens. Endometrial carcinomas start from cells in the organs of the endometrium (uterine coating). These include well-differentiated endometrioid adenocarcinoma, which is common and easy to treat, as well as uterine papillary serous carcinoma, which is more serious and uterine clear-cell carcinoma.

Endometrial Disease

Polycystic Ovary Syndrome (PCOS) is an exceptionally heterogeneous problem influencing roughly 6%-15% of womens of regenerative age. Portrayed by a range of conceptive, metabolic and endocrine, hyperinsulinemia, type 2 diabetes mellitus and cardiovascular illness, it stays a complicated condition with no recognized orderly reason to date. Although hormone imbalance is cited as a risk factor for uterine cancer, the exact causes are unknown. Estrogen receptors, known to be available on the surfaces of cells of this sort of disease, are remembered to communicate with the chemical causing expanded cell development, which can then bring about malignant growth. Uncertainty surrounds the precise mechanism by which this occurs. Anticipation shifts for the various sorts of endometrial disease. Factors that impact guess across sorts of uterine disease are age at conclusion, the phase of the malignant growth, the grade of the malignant growth, histology, profundity of intrusion into the myometrium and the presence of spread to local lymph hubs or other regions. Endometrial disease commonly has a decent 5-year-endurance when analyzed early. By and large, the visualization is less fortunate for uterine sarcomas when contrasted with endometrial tumors. Lean womens are probably going to have a missed determination of diabetes and cardiovascular illness. These ladies additionally have an expanded gamble of creating insulin opposition, regardless of not being overweight. Lean ladies are frequently viewed less in a serious way with their determination of PCOS and furthermore face difficulties tracking down fitting treatment choices. This is on the grounds that most treatment choices are restricted to approaches of getting in shape and sound consuming less calories.

Perspective

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Nature-Inspired Strategies for Biomimetic Mineralization

Lin Chen*

Department of Biomedical Engineering, University of Science and Technology, Anhui, China

Corresponding author: Lin Chen, Department of Biomedical Engineering, University of Science and Technology, Anhui, China, E-mail: Chen_L@gmail.com

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Description

Propelled by these extraordinary benefits, researchers attempt to repeat the assembling procedures and underlying elements of biomineralization through synergetic blend of inorganic materials and bioactive creatures. In this way, following the recognized systems of biomineralization, the biomimetic mineralization is turning into an arising research field for planning and designing living beings. In the current audit, we sum up the new accomplishments in understanding and utilizations of biomineralization-based organic entities designing. We focus on methods that enable organisms like viruses, bacteria and cells to be endowed with addressable structures and excellent physiological properties in order to facilitate unnatural functions like environmental resistance, biological enhancement, tumor therapy and cell-based delivery in the design of application-oriented material-organism hybrids.

Biomimetic Nanohybrids

The use of microstructural image data as a template is necessary for biomimetic design. This imaging data could come from confocal microscopy, micro-MRI, or micro-computed tomography (micro-CT). Biomimetic scaffold microstructures were developed on the basis of human trabecular bone architecture. Scaffolds made of polylactic acid and nylon-6 have been constructed using these faceted data. Biomimetic plans present extra impediments since the size of natural tissue ancient rarities is in many cases underneath the element goal of most freestyle creation frameworks. These characteristics, on the other hand, can be scaled up for fabrication while maintaining porosity sizes that are ideal for tissue regeneration. Biomimetic nanohybrids have been advanced as the potential medication transporters in the beginning phases of improvement and approval since they have the capacities to impart to cells. Malignancies that can kill, like breast, lung, glioblastoma and the pancreas, require more specialized treatments. Current methodologies don't treat a considerable lot of these tumors effectively. Because of the natural beginning of these biomimetic nanohybrids, they have one of a kind capacity to resolve issues with nanoparticle-based drug conveyance. Expanded explicitness and diminished freedom time because of the presence of surface proteins, makes them promising medication transporters for designated conveyance therapeutics.

Biomineral Materials

Biomineralization alludes to the powerful physiological cycles by which living beings structure inorganic minerals. By and large, creatures control the biomineralization cycle utilizing organic macromolecules like proteins, peptides, nucleic acids, polysaccharides and lipid bilayers, which assume a fundamental part in directing the nucleation, development and direction development of minerals, bringing about the development of various leveled structures. During biomineralization process, nucleation as an underlying step can drives particles to the dynamic destinations for heterogeneous development of another stage. To accomplish productive nucleation, supersaturation has been found as a significant main thrust. For instance, a few organic entities use intracellular vesicles as transient compartments to store the indistinct minerals, which are then shipped to the calcification site to lift the nearby supersaturation for ensuing neucleation. Normal biomineralization processes energize the biomimetic mineralization strategies, which can give a flexible stage to designing living cells and creatures practically equivalent to with client characterized capabilities. Following the systems of biomineralization, the biomacromolecules are expected for morphology and capability control during the reconciliation of organic entities and inorganic materials the main contrast being that the guideline of living creatures is dynamic. Accordingly, notwithstanding static joining of materials, the metabolic guideline likewise permits hearty downstream union of materials-mixture designs to give new capacities. Lately, with the fast improvement of biomimetic innovation, the reconciliation of biomineral materials with the creatures is reachable upon the advanced idea of biomineralization. Contrasted and other designing methodologies like genetical designing and bio-formation designing, biomimetic mineralization may be the most straightforward and productive system for researchers to tailor the capability of organic entities, like security against brutal climate, shift of natural acknowledgment and designing cell reactions.

Research Article

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Role of N-Acetylcysteine in Prevention of Contrast Induced Nephropathy in Diabetic Patients Undergoing Coronary Angiography or PCI

Rahmatullah[1], Sher Alam Montaqee[2], Mohammad Sarwar Khan Tharin[3], Mujahid Raza[4], Musa Khan[5], Ishil Bangash[6] and Saleem Abbasi[7*]

[1]Department of Cardiology, Pakistan Institute of Medical Sciences, Islamabad, Pakistan

[2]Department of Gastroenterology, Pakistan Institute of Medical Sciences, Islamabad, Pakistan

[3]Department of Cardiology, Colchester General Hospital, Colchester, UK

[4]Department of Radiology, Pakistan Institute of Medical Sciences, Islamabad, Pakistan

[5]Principal Demonstrator, Saidu Medical College, Swat, Pakistan

[6]Medical Officer, MCH Center, Islamabad, Pakistan

[7]Department of Epidemiologist, Pakistan Institute of Medical Sciences, Islamabad, Pakistan

Corresponding author: Saleem Abbasi, Department of Epidemiologist, Pakistan Institute of Medical Sciences, Islamabad, Pakistan, E-mail: saleemsw@hotmail.com

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Abstract

Introduction: Contrast Induced Nephropathy (CIN) is generally reversible form of acute kidney injury that occurs after radio-contrast media administration. There is enormous variation and contradictory results regarding effectiveness of N-Acetylcysteine (NAC) in preventing CIN. This study intended to assess the protective role of N-Acetylcysteine in terms of reducing renal morbidity.

Objective: To determine mean change in serum creatinine levels before and after coronary angiography in diabetic patients treated with N-Acetylcysteine in comparison with placebo.

Methodology: A total of 286 adult diabetic patients undergoing coronary angiography/percutaneous coronary intervention were selected from Department of Cardiology, PIMS, Islamabad in a period of 6 months from 30-12-2020 to 29-06-2021. Patients were randomly assigned to controls in group A (n=143) who received normal saline and normal saline and oral NAC 600 mg in group B (n=143). Serum creatinine was estimated before and 3 days after coronary angiography. All patients received low-osmolal contrast media. Data was entered and analyzed using SPSS software version 17.0.

Results: The mean age was 58.1 ± 9.4 years in group A and 57.5 ± 9.9 years in group B (P=0.853). Gender distribution was also found similar. Mean serum creatinine levels post procedure in group A was 1.0213 ± 0.235 mg/dL and 1.016 ± 0.239 mg/dL in group B (P=0.857).

Conclusions: No statistically significant change in serum creatinine levels was observed after coronary angiography in diabetic patients treated with N-Acetylcysteine in comparison with placebo.

Keywords: Contrast induced nephropathy; Percutaneous coronary intervention; Coronary angiography

Introduction

Contrast Induced Nephropathy (CIN) is a generally reversible form of Acute Kidney Injury (AKI) that takes place soon after the administration of radio-contrast media [1]. The data from animal models best describe the pathogenesis of CIN [2]. The reported incidence of CIN show wide variations, largely depending upon the presence or absence of risk factors, like underlying Chronic Kidney Disease (CKD) and varies between 8% to 16% depending upon age and comorbidities [3,4].

Various researches showed evidence of Acute Tubular Necrosis (ATN), mainly due to cytotoxic effects of contrast agents. However, this mechanism is not well understood. Another theory is that ATN is caused by renal vasoconstriction resulting in medullary hypoxia, possibly mediated by changes in nitric oxide, endothelin and/or adenosine [5]. However, unlike other types of ATN, CIN is usually characterized by relatively rapid recovery of renal function [6].

Acetylcysteine is a thiol compound with antioxidant and vasodilatory properties which is found effective in the prevention of CIN [7]. Given the conflicting data regarding benefit, researchers cannot make a strong recommendation regarding the use of acetylcysteine in routine clinical practice.

Since the agent is potentially beneficial, well tolerated and relatively inexpensive, the 2012 Kidney Disease Improving Global Outcomes (KDIGO) guidelines recommend its use in subjects who are at high risk of developing CIN [8]. The overall preventive effects of NAC have been evaluated in multiple pooled analyses. Some have suggested a considerable beneficial effect, with reported risk reductions of up to 50% [9,10]. In one pooled analysis, it was reported that N-Acetylcysteine significantly lowered the risk for CIN when compared with saline only (RR 0.62, 95% CI 0.44-0.88) [11]. Pezeshgi et al. assessed the protective effect of N-acetylcysteine on CIN in diabetic patients and found mean baseline serum creatinine of 1.21 ± 0.35 mg/dL in the control group and 1.17 ± 0.35 mg/dL in NAC group while after 3 days values were 1.34 ± 0.44 mg/dL and 1.08± 0.34 mg/dL respectively (P<0.05) [11].

There is enormous variation and contradictory results in the available clinical studies and pooled analyses examining the effectiveness of acetylcysteine in preventing CIN [10,11]. It was intended to gather the data about its protective role in the local settings. If any favorable results are observed in terms of clinical response, NAC may be recommended for further routine clinical use. This would be beneficial in reducing the renal morbidity associated with the contrast media. The study aim was to determine the mean change in serum creatinine levels before and after coronary angiography in diabetic patients treated with N-Acetylcysteine in comparison with placebo.

Materials and Methods

This Randomized Controlled Trial (RCT) was carried out in Cardiology Department, PIMS and Islamabad in a period of six-months from 30-12-2020 to 29-06-2021. A total of 286 adult patients diagnosed with diabetes mellitus undergoing PCI or coronary angiography were selected for this study.

Patients were randomly assigned to two groups. Patients were hydrated with saline, in control group (group A) normal saline only was given while the case group (group B) received normal saline and oral NAC 600 mg twice daily given a day before angiography and continued until the 2nd day after angiography. All patients received low-osmolal contrast media. Exact estimates of the doses of contrast agent administered were not available. Patients were allowed to continue to take their previously used medications.

Patients who were on anti-diabetic medicine and planned for coronary angiography for evaluation and management of coronary artery disease having age >18 years and of both genders were included. Patients with H/O allergy to iodinated contrast media and who had baseline creatinine more than 1.8 mg/dl were excluded. Ethical clearance was obtained and a written informed consent was taken.

The information regarding demographic characteristics and clinical presentation was recorded. Serum creatinine was estimated before and 3 days of coronary angiography. All patients received low-osmolal contrast media. All the information was recorded on the prescribed proforma.

Data was entered and analyzed using SPSS software version 22.0. The continuous numerical variables were described as mean ± SD. Categorical variables were recorded as frequency and percentage in both groups. Mean difference between baseline and 3 days post angiography creatinine levels was determined in both groups. Student-t test was applied to assess the significance of mean difference pre and post angiography in both groups. A P-value of ≤ 0.05 considered significant.

Results

The mean age was 58.1 ± 9.4 years in group A and 57.5 ± 9.9 years in group B. In group A, there were 40 (28.0%) patients between 18 to 50 years of age and 103 (72.0%) had age more than 50 years while in group B, there were 35 (24.5%) and 10 (75.5%) in these age groups respectively. This distribution was similar in both groups (P=0.501). There were 88 (61.5%) males in group A (control) and 92 (64.3%) in group B NAC while 55 (38.5%) females in group A and 51 (35.7%) in group B and this difference in gender distribution among two groups was not statistically significant (p-value, 0.624) **(Table 1)**.

Table 1: Demographic characteristics of patients in two groups.

	Group A (Control) (n=143)	Group B (NAC) (n=143)	P-value
Gender			
Males	88 (61.5%)	92 (64.3%)	0.624
Females	55 (38.5%)	51 (35.7%)	
Age categories (years)			
Up to 50	40 (27.9%)	35 (24.4%)	0.661
>50	103 (72.0%)	108 (75.6%)	
Age (years)			
Mean ± SD	58.1 ± 9.4	57.5 ± 9.9	0.653

Analysis of duration of diabetes at baseline showed that in group A 68 (47.6%) patients had duration of diabetes less than 5 years, 48 (33.6%) reported duration of 6-10 years, 19 (13.3%) reported duration of 11-15 and 8 (5.6%) reported duration of more than 15 years while in group B, 69 (48.3%), 40 (28.0%), 18 (12.6%) and 16 (11.2%) were found in these age categories respectively. The age distribution was similar in both groups (P=0.330). There were 95 (66.4%) patients in group A, who had undergone coronary angiography and 48 (33.6%) underwent PCI while in group B, 94 (65.7%) and 49 (34.3%) were found so, respectively. The distribution was similar in both groups (P=0.901) **(Table 2).**

Table 2: Clinical details of patients in the two groups.

	Groups		**P-value**
	Group A (Control) (n=143)	**Group B (NAC) (n=143)**	
Duration of diabetes (years)			
Up to 5	68 (47.6%)	69 (48.3%)	0.33
6 to 10	48 (33.6%)	40 (28.0%)	
11 to 15	19 (13.3%)	18 (12.6%)	
>15	8 (5.6%)	16 (11.2%)	
Cardiac procedures			
Angiography	95 (66.4%)	94 (65.7%)	0.95
PCI	48 (33.6%)	49 (34.3%)	

The mean serum creatinine levels at baseline in group A was 1.021 ± 0.235 mg/dL and it was 1.015 ± 0.238 mg/dL in group B and no difference was observed in these levels (P=0.834). The mean serum creatinine levels post procedure in group A was 1.0213 ± 0.235 mg/dL and it was 1.016 ± 0.239 mg/dL in group B. No significant difference was observed in the post procedure serum creatinine levels in both groups (P=0.857). Overall the change in mean serum creatinine levels post procedure in group A and group B were similar and no significant difference was observed in both groups (P=0.338) **(Table 3)**.

Table 3: Comparison of serum creatinine between two groups.

	Group A (Control) (n=143)	**Group B (NAC) (n=143)**	**P-value**
Serum creatinine (Baseline)			
Mean ± SD	1.02 ± 0.23	1.05 ± 0.24	0.834
Serum creatinine (Post intervention)			
Mean ± SD	1.02 ± 0.22	1.01 ± 0.23	0.857
Overall post intervention change in serum creatinine levels (mg/dL)			
Mean ± SD	0.0002 ± 0.0098	0.0006 ± 0.0063	0.337

Discussion

This study has found that N-Acetylcysteine (NAC) has a significant preventive role against emergence of contrast induced nephropathy. Historically, there is enormous variation and contradictory findings in the available evidence from clinical studies and pooled analysis evaluating the effects of N-Acetylcysteine (NAC) in the prevention of CIN. The protective findings of NAC in CIN have been witnessed in many trials before as well.

There was no difference in the level of serum creatinine from baseline to 3 days post intervention among the controls and N-Acetylcysteine (NAC) in the current study. The average decrease in serum creatinine levels was minimal in both groups after 3 days of PCI or CABG procedures. The published incidences of CIN show wide variations that depend on how AKI is defined and whether the risk factors (CKD, type and dose of contrast agent, type of radiological procedure *etc*.) are present or absent. Studies have demonstrated that risk of AKI depends on the dose and type of the contrast agent with low osmolal agents and lower doses of contrast being safer [12]. In the present study a low osmolal agent was used in all the patients, however, exact estimates of the doses of contrast agent administered were not available.

Many studies and meta-analysis have been found in the literature showing mixed results some have approved while others have rejected the effect of NAC on intravenous CIN. Bagshaw et al., in their meta-analysis on 1261 patients in 14 studies reported that only in 5 studies the risk of contrast induced nephropathy was lower after administration of NAC while other studies showed no effect [13]. van den Berk et al., analyzed 16 studies in a meta-analysis, they found that five of them showed significant effects of NAC [14]. In another study on different doses of NAC authors reported that the protective effect of NAC with a dose of 1200 mg twice daily was more than that with a dose of 600 mg [15]. Liu et al., in their pooled analysis which included 9 RCTs reported that NAC was effective for the prevention of CIN because it was low-risk and low cost, and was advisable to use [16]. In another meta-analysis, Gonzales et al. analyzed 22 studies with 2746 patients and reported that no protective effects of NAC on CIN were observed [17]. In a large multicenter ACT randomized controlled trial, from Brazil, 2300 high-risk patients were assessed for CIN and underwent coronary angiography. The patients who received 1200 mg of oral NAC were compared with the placebo. It was demonstrated that incidence of CIN was lower in NAC group. Pezeshgi et al., in their prospectively designed clinical study determined the effect N-acetylcysteine in reducing the incidence of CIN in patients who underwent coronary angiography [9,11]. The intervention group showed a statistically significant drop in creatinine levels compared with control ($P<0.05$). Incidence of CIN was more in control group compared with NAC ($P<0.05$). They concluded that N-acetylcysteine does have the protective effects in preventing CIN. Additionally in a meta-analysis by Kwok et al. a significant reduction of CIN risk was reported by administration of NAC, which supported its protective effect [18]. Compared to these evidences of protective effect of NAC, the current study also found that mean change in creatinine levels pre and post intervention were not statistically significant.

In many instances, the related factors and comorbidities have been witnessed having variable effect over the patient outcomes. The reported incidences of CIN show wide variations, largely depending upon the presence or absence of risk factors [19]. The management is not yet specified once contrast-induced Acute Kidney Injury (AKI) develops, rather these patients are managed as for the etiology with the aim of preserving fluid and electrolyte balance. In most cases, there are no permanent consequences, however, it has been reported that its development may be associated with adverse outcomes [20]. Acetylcysteine is a thiol compound having antioxidant and vasodilatory characteristics. A likely mechanism of action that is involved in preventing CIN is to minimize both vasoconstriction and production of oxygen-free radical after administration of radio-contrast agent [21]. There is also enormous variation and contradictory findings regarding the effects of N-Acetylcysteine (NAC) in preventing CIN. It has been published in several reports that incidence of CIN is higher among patients with CKD, and the degree of the risk is directly related with the severity of renal dysfunction [22].

It has been reported that in patients with CKD, diabetic patients are at higher risk for contrast nephropathy compared with non-diabetic patients [23]. Among subjects with normal kidney function, diabetes does not enhance the risk of contrast nephropathy [24]. The same effect has been observed in the current study, as all patients had baseline creatinine levels ≤ 1.8 mg/dL and only few had creatinine levels between 1.5 mg/dL to 1.8 mg/dL. Magnitude of change in post-procedure creatinine levels did not appear to be in statistically significant range between both groups.

The advantages of this study are numerous as firstly, there were no or very few attempts done in the local settings. Secondly, a comparative trial was accomplished with a control group, thus, providing a true effect of the NAC intervention in preventing CIN.

This study has some limitations as well, firstly, the exact dose of the contrast agent administered was not measured. Secondly, the subjects with serum creatinine levels >1.8 mg/dL were not enrolled in the study. And thirdly due to limited study duration, the sample size was relatively small.

In brief, reported incidences of CIN show wide variations that depend on how AKI is defined and whether the risk factors (CKD, type and dose of contrast agent, type of radiological procedure *etc*.) are present or absent. Studies on protective role of NAC also show mixed results with evidence more in favor of no significant protective effect of NAC on CIN.

Conclusion

No statistically significant change in serum creatinine levels was observed in this study before and after coronary angiography in diabetic patients treated with N-Acetylcysteine in comparison with placebo. Before generalization of these findings, it is recommend that further large scale studies including patients with serum creatinine levels more than 1.8 mg/dL should be conducted.

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